







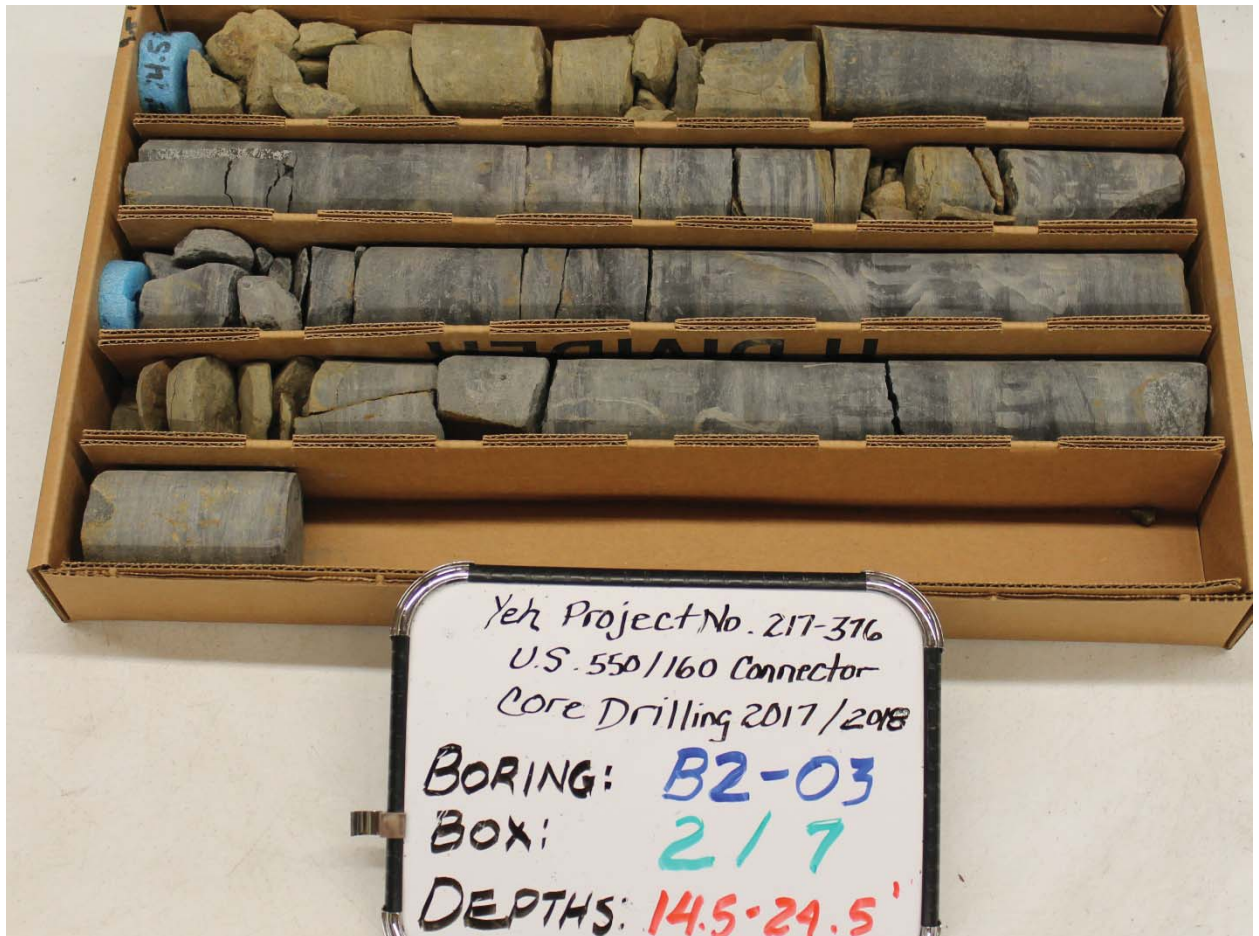
Yeh Project No. 217-316  
U.S. 550/160 Connector  
Core Drilling 2017/2018

BORING: B2-02

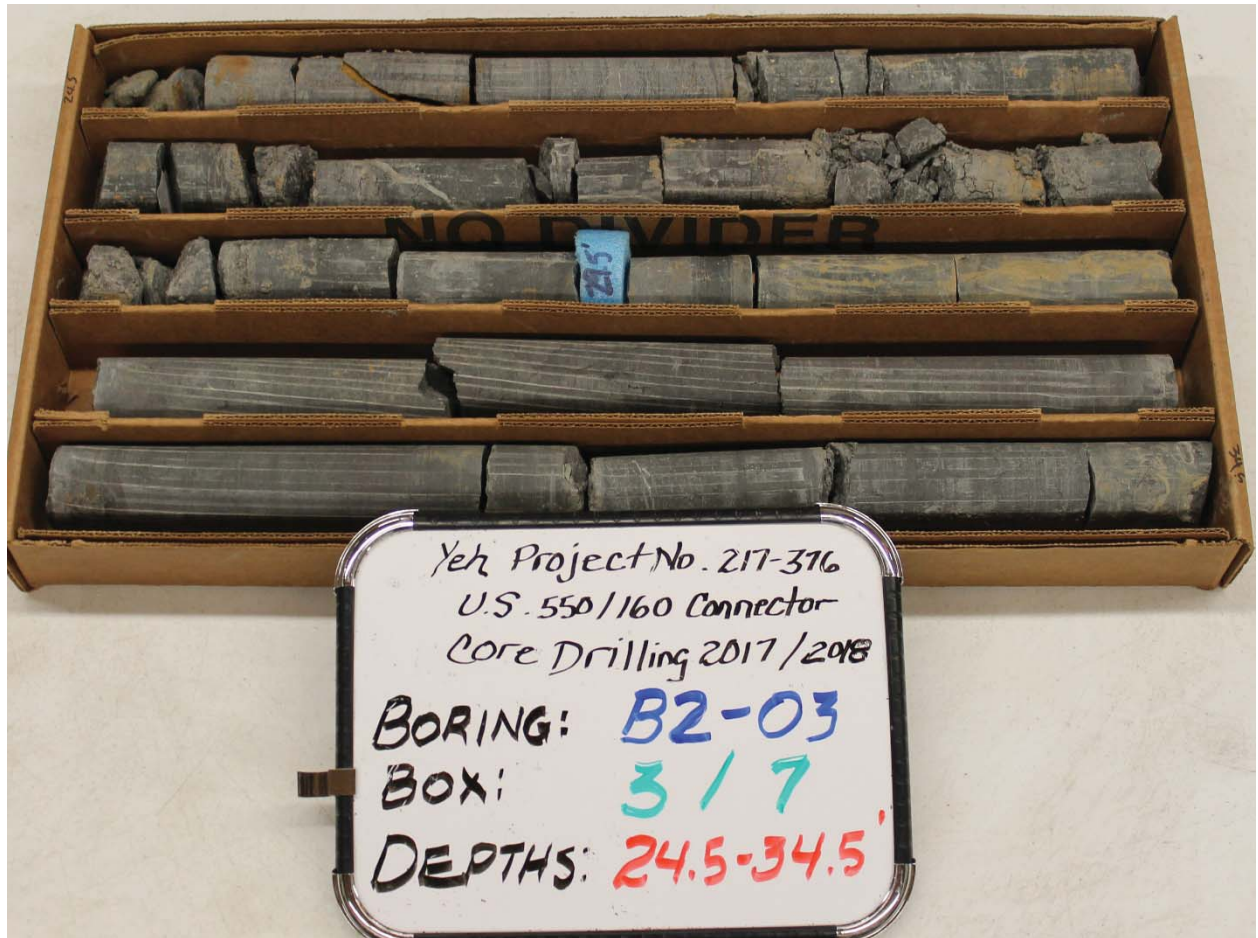
BOX: 717

DEPTHS: 65.2-70.2'

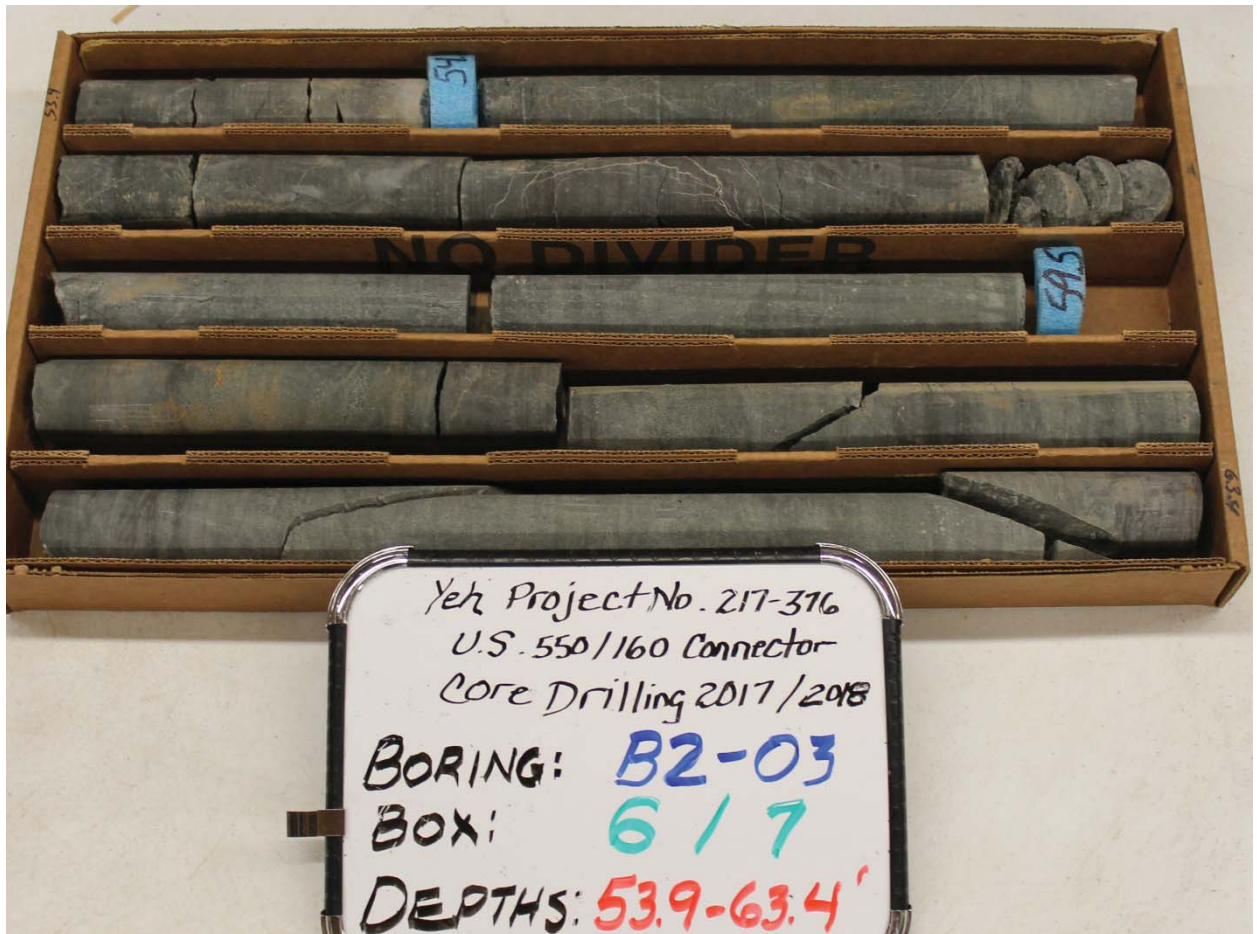














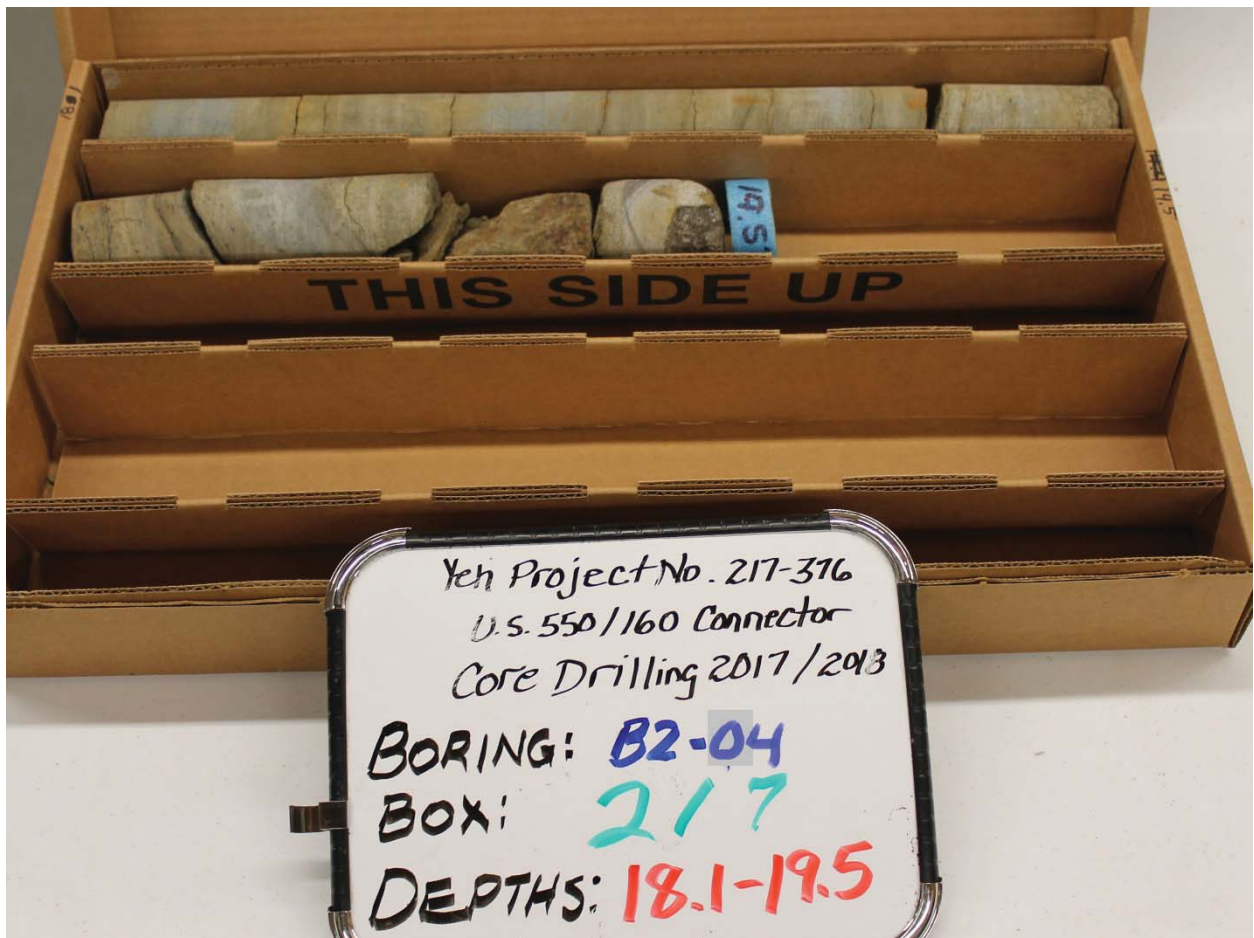
Yeh Project No. 217-316  
U.S. 550/160 Connector  
Core Drilling 2017/2018

BORING: B2-03

BOX: 7 / 7

DEPTHS: 634-69.0'









Yeh Project No. 217-316

U.S. 550/160 Connector

Core Drilling 2017/2013

BORING: B2-04

BOX: 3 / 7

DEPTHS: 19.5-32.4'



Yeh Project No. 217-316

U.S. 550/160 Connector

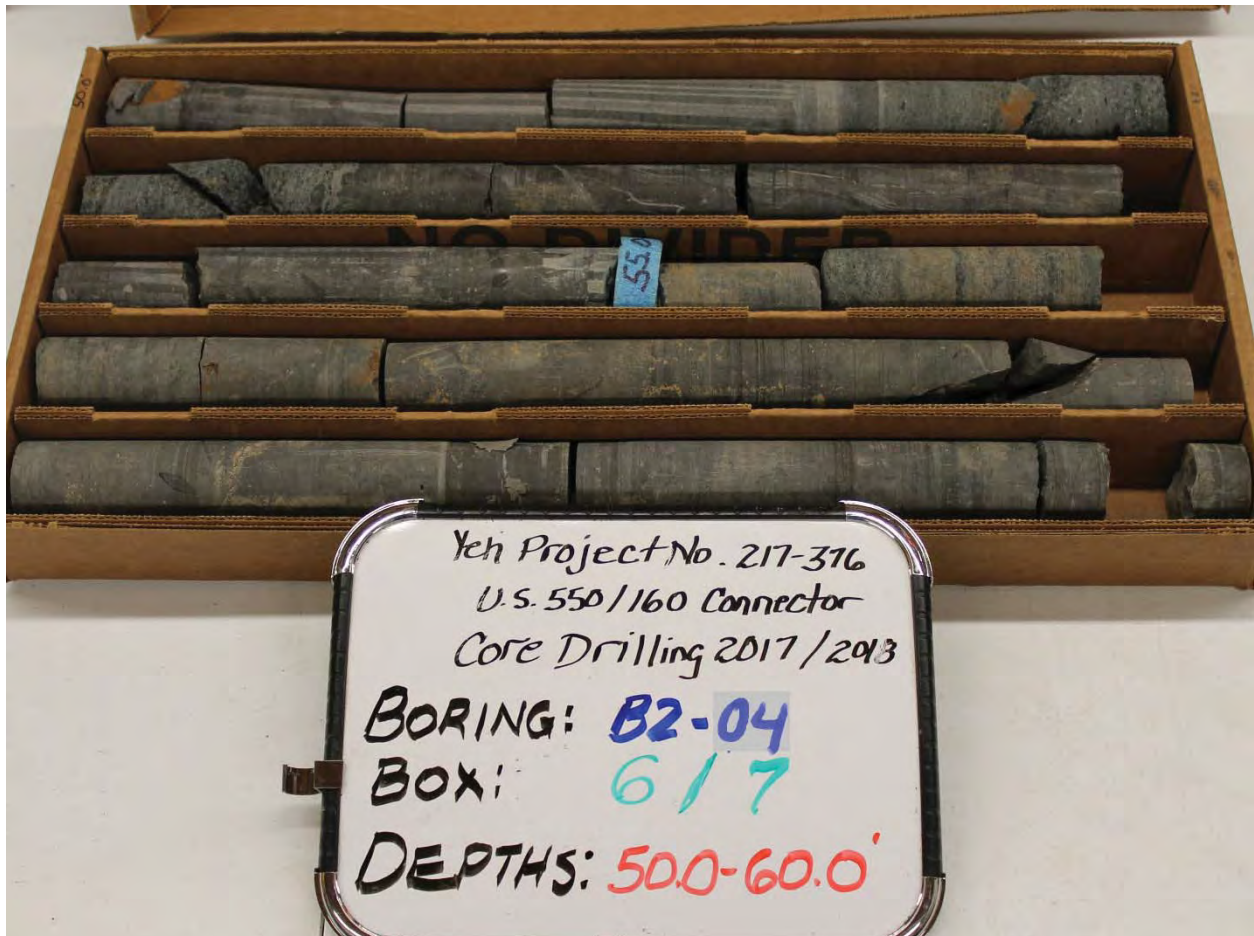
Core Drilling 2017/2013

BORING: B2-04

BOX: 4 / 7

DEPTHS: 32.4-42.2'









Yeh Project No. 217-316  
U.S. 550/160 Connector  
Core Drilling 2017/2013

BORING: B2-04

BOX: 7/7

DEPTHS: 60.0-69.9'



**Appendix F.4 – Retaining Walls Borings – Core Photos**

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Yeh Project No. 217-376  
US 550/160 Connection  
Core Drilling 2017/2018

**BORING:** WA-01

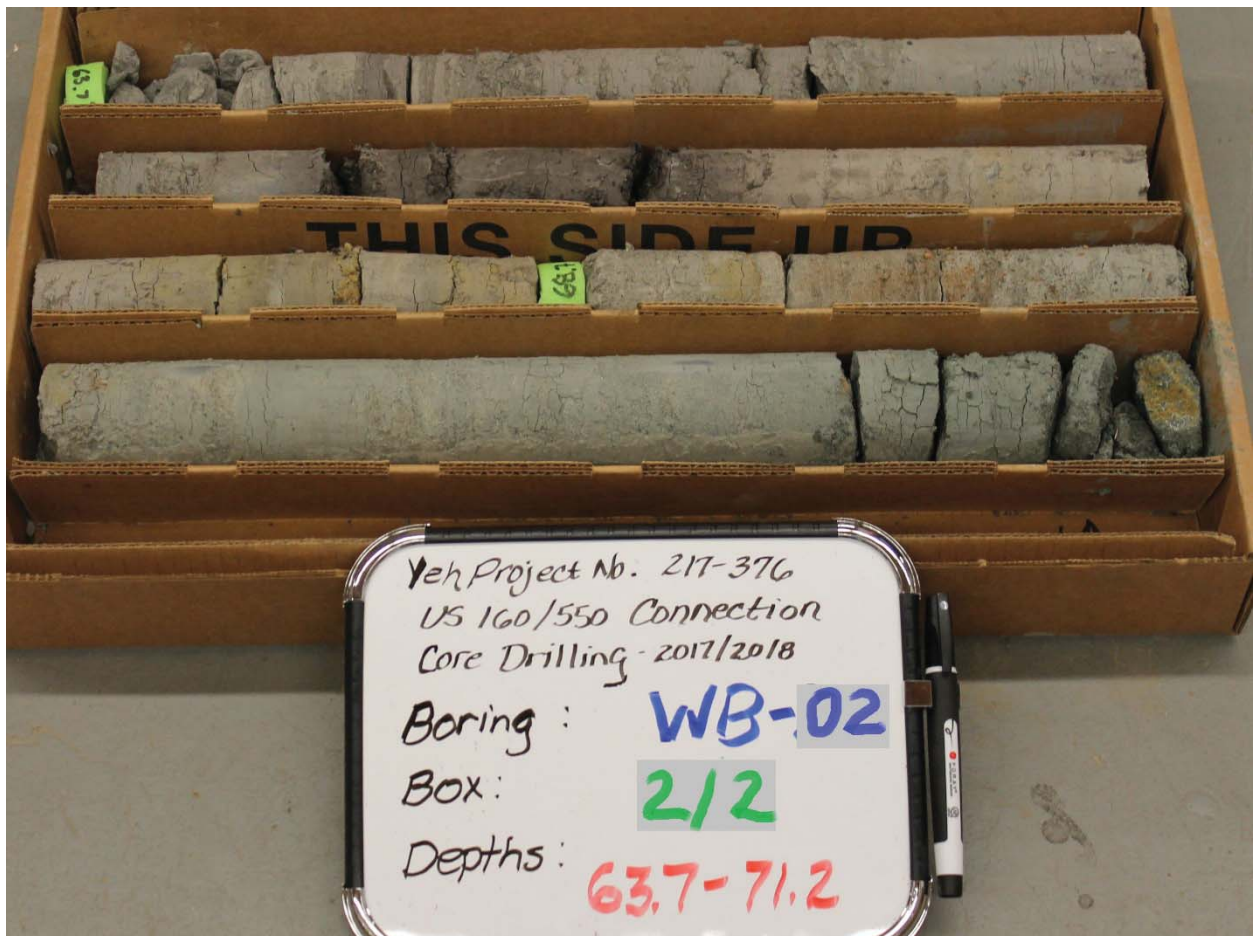
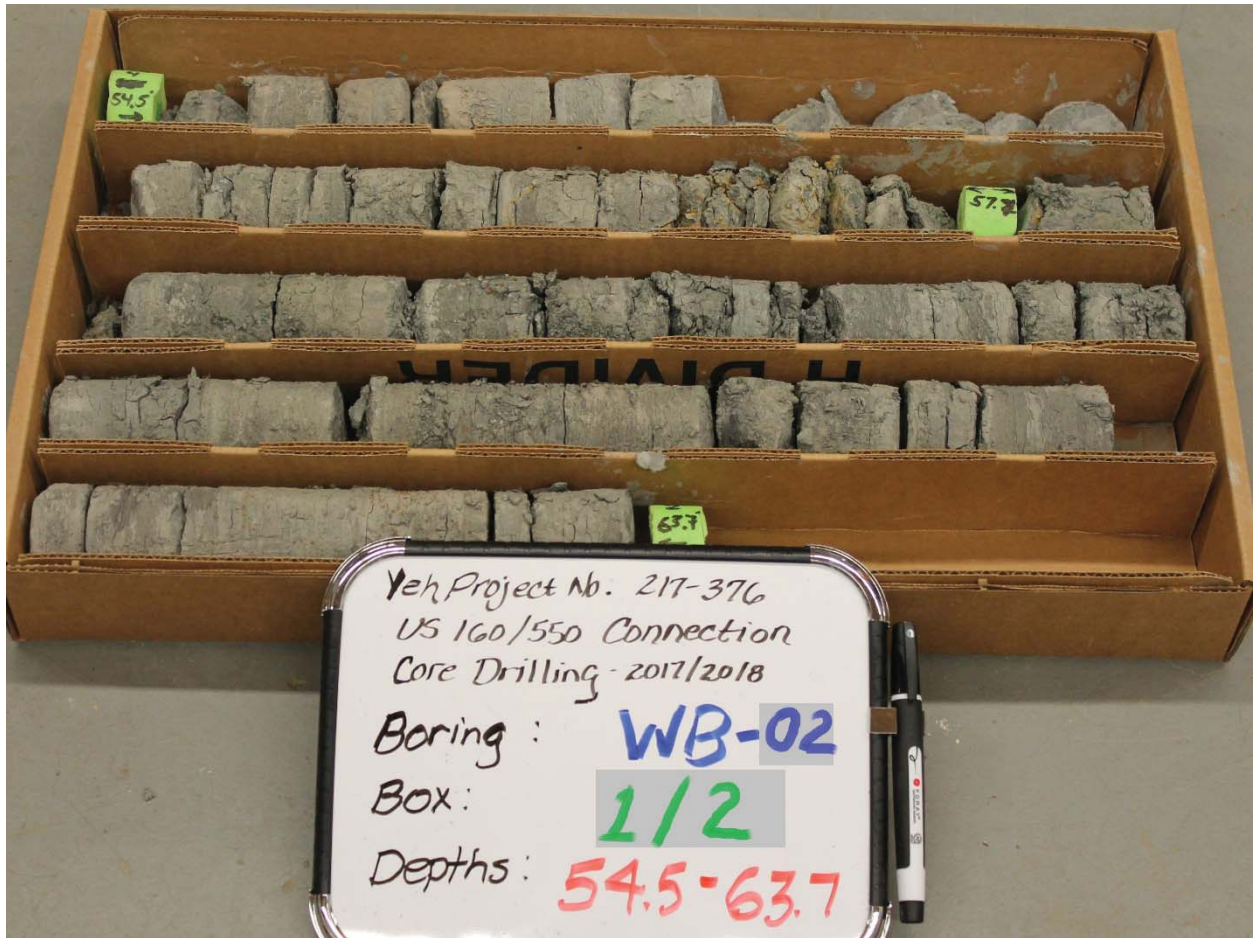
**BOX:** 1/1

**DEPTHS:** 54.8-64.0









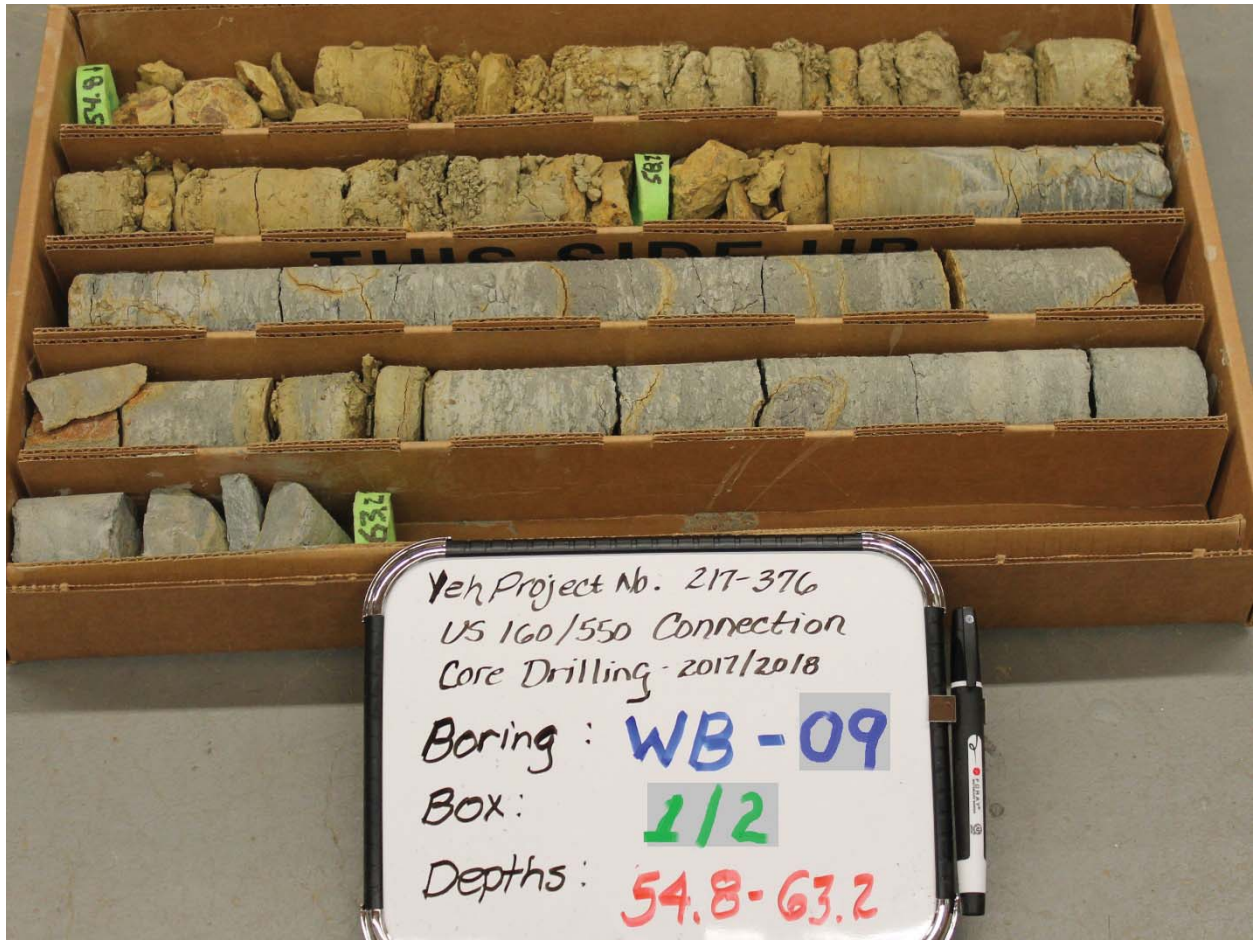




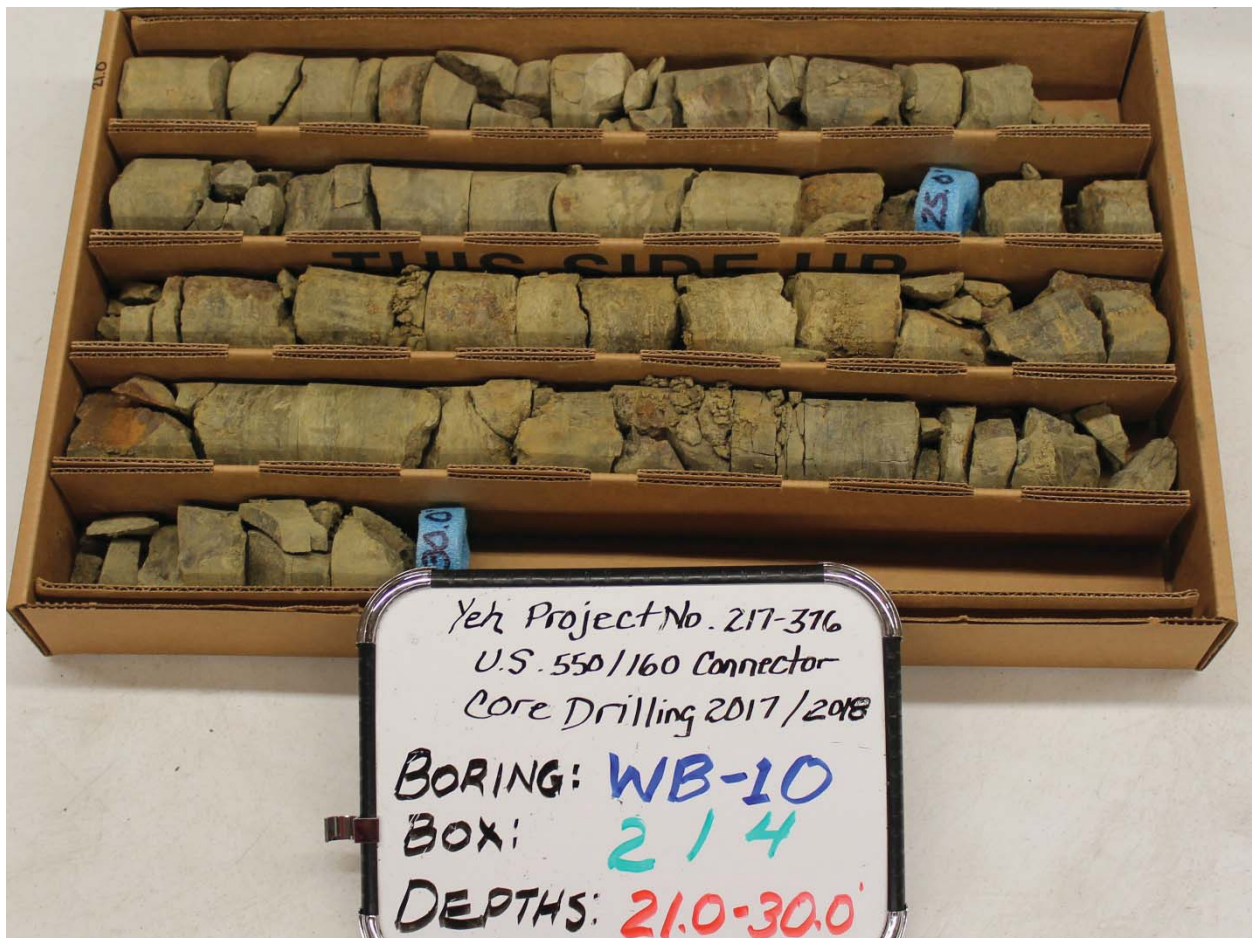
Yeh Project No. 217-376  
US 550/160 Connection  
Core Drilling 2017/2018  
BORING: WB-06  
BOX: 1/1  
DEPTHS: 59.5-69.0



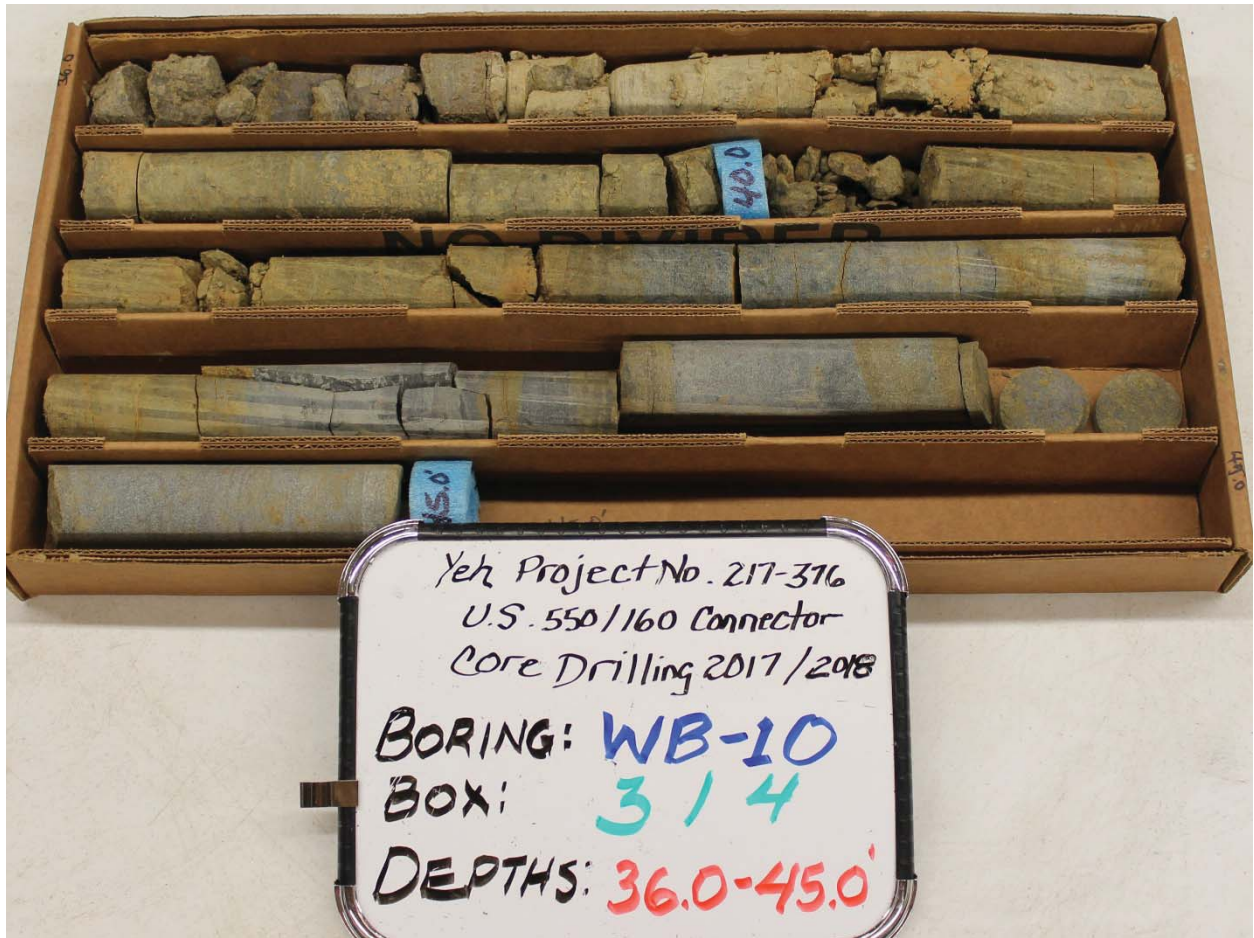








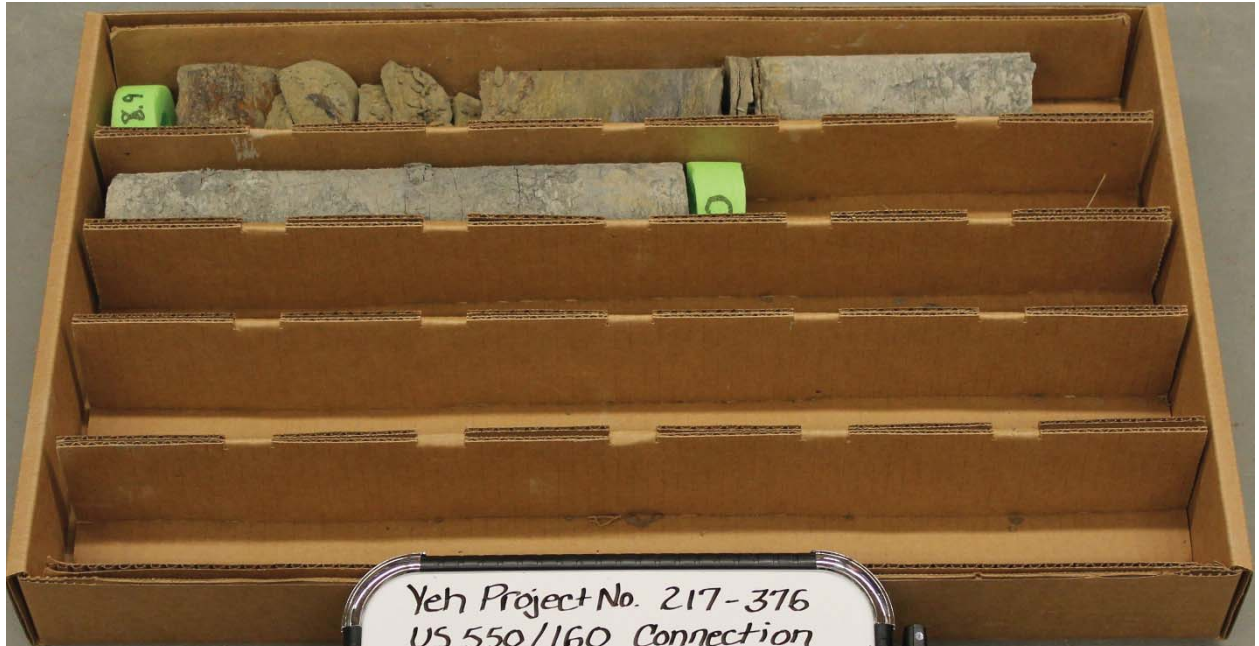












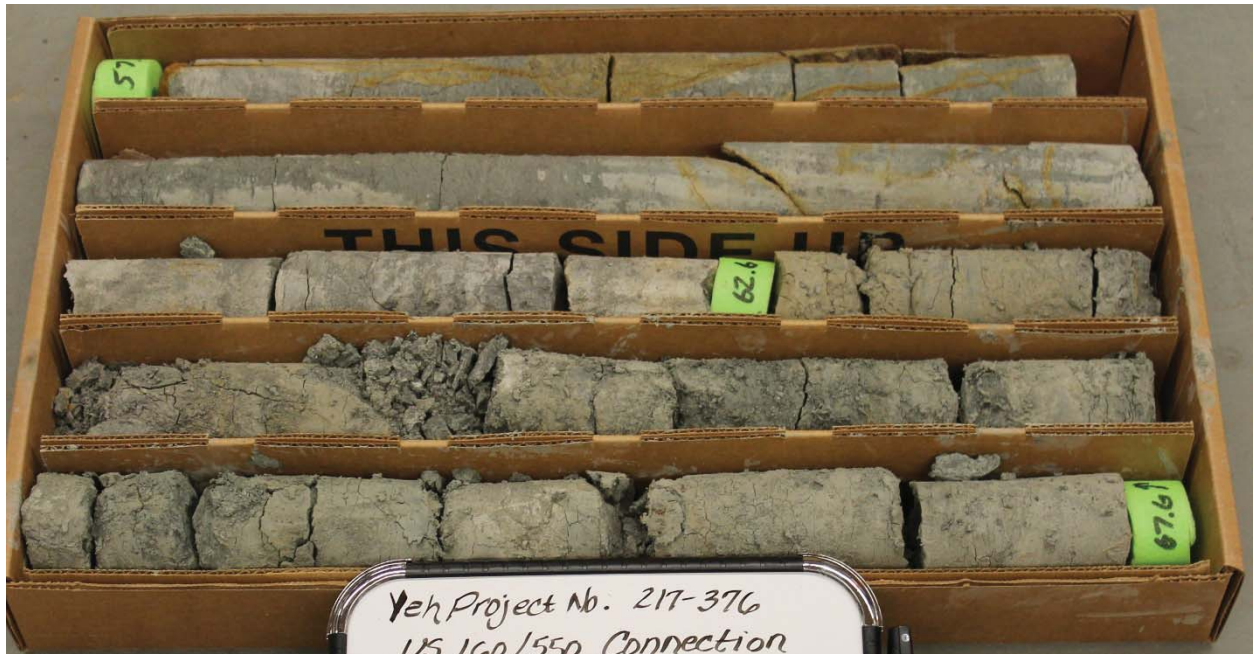
Yeh Project No. 217-376  
US 550/160 Connection  
Core Drilling 2017/2018

**BORING:** WC-01  
**Box:** 3/3  
**DEPTHS:** 58.9-61.8









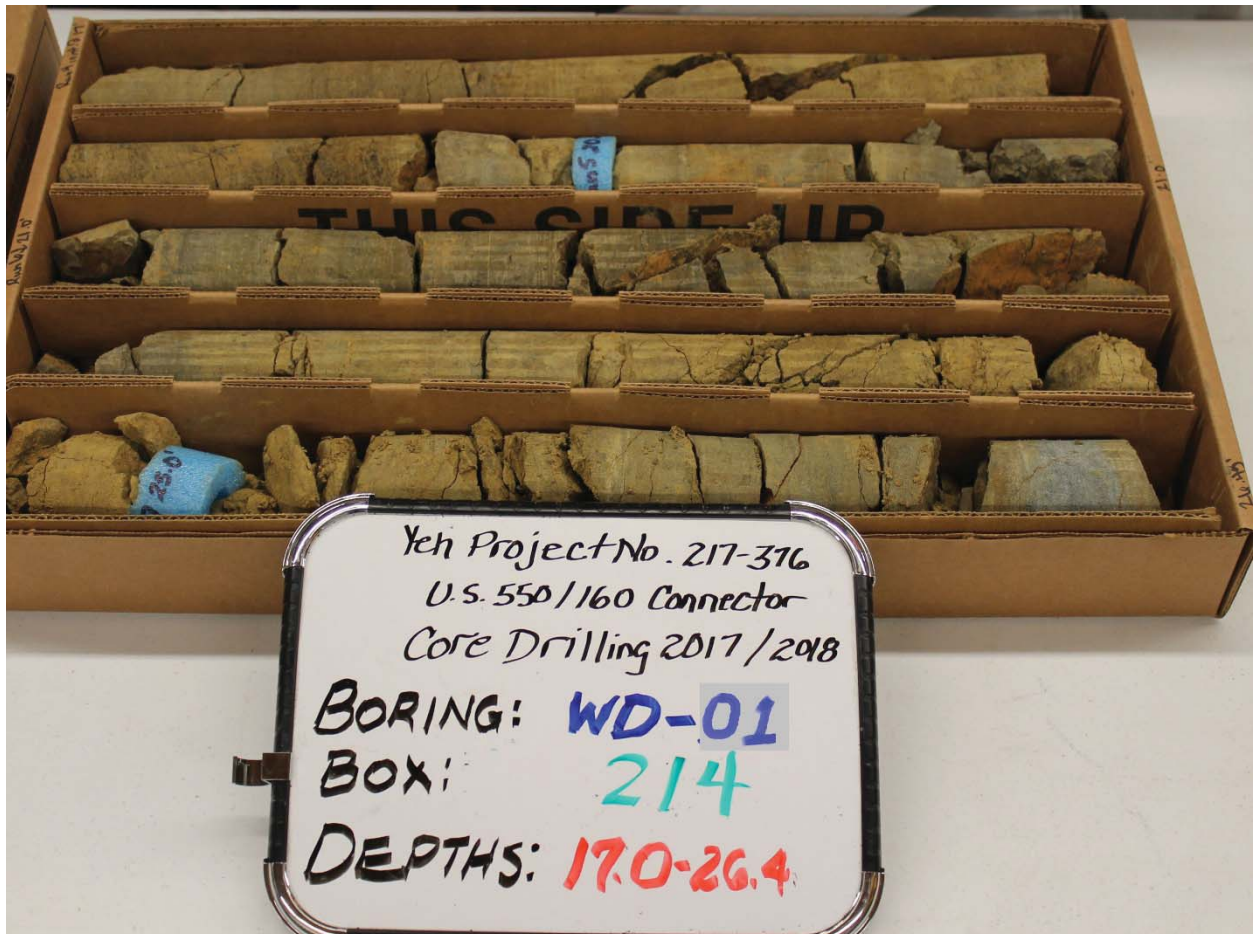
Yeh Project No. 217-376  
US 160/550 Connection  
Core Drilling - 2017/2018

Boring : WC-03

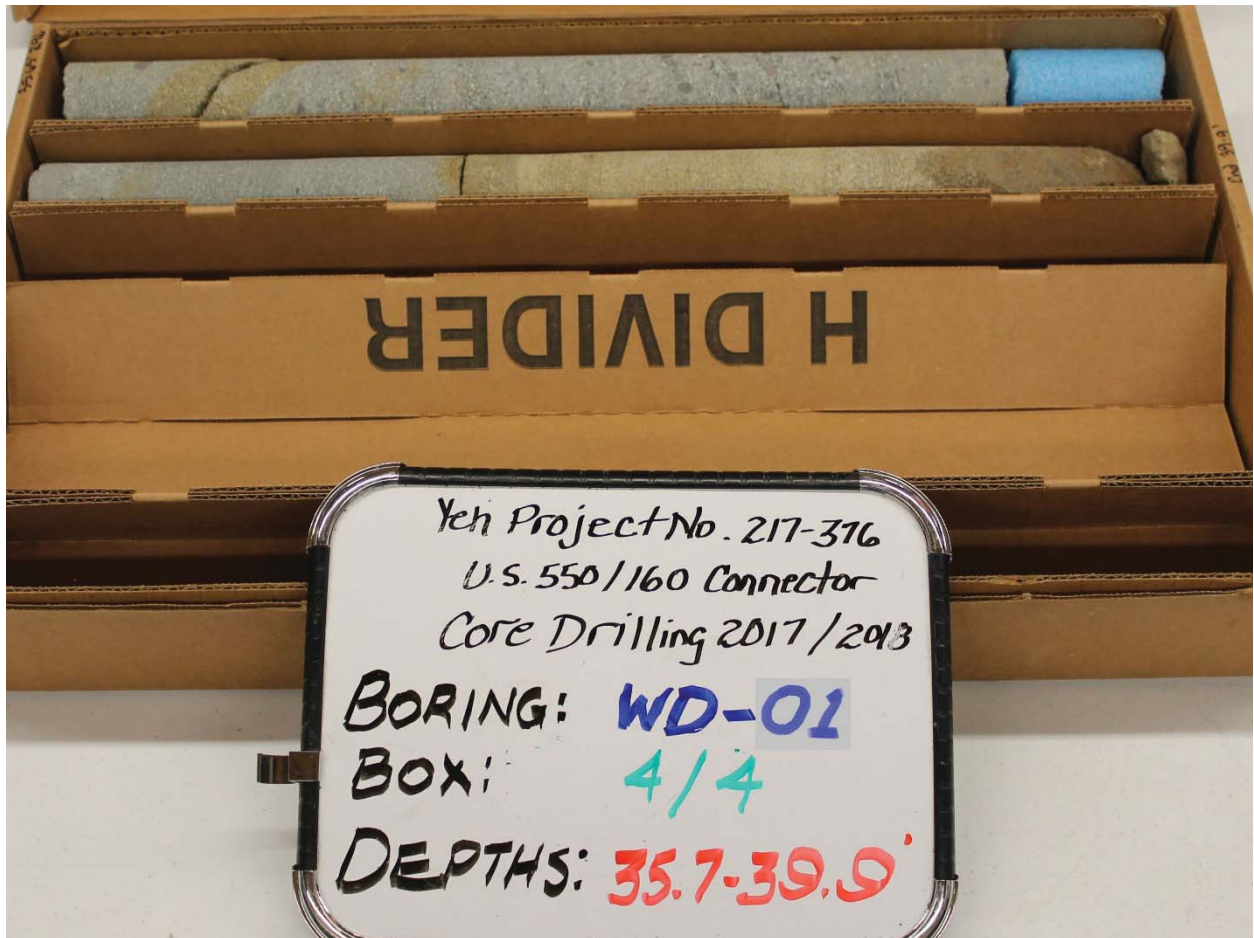
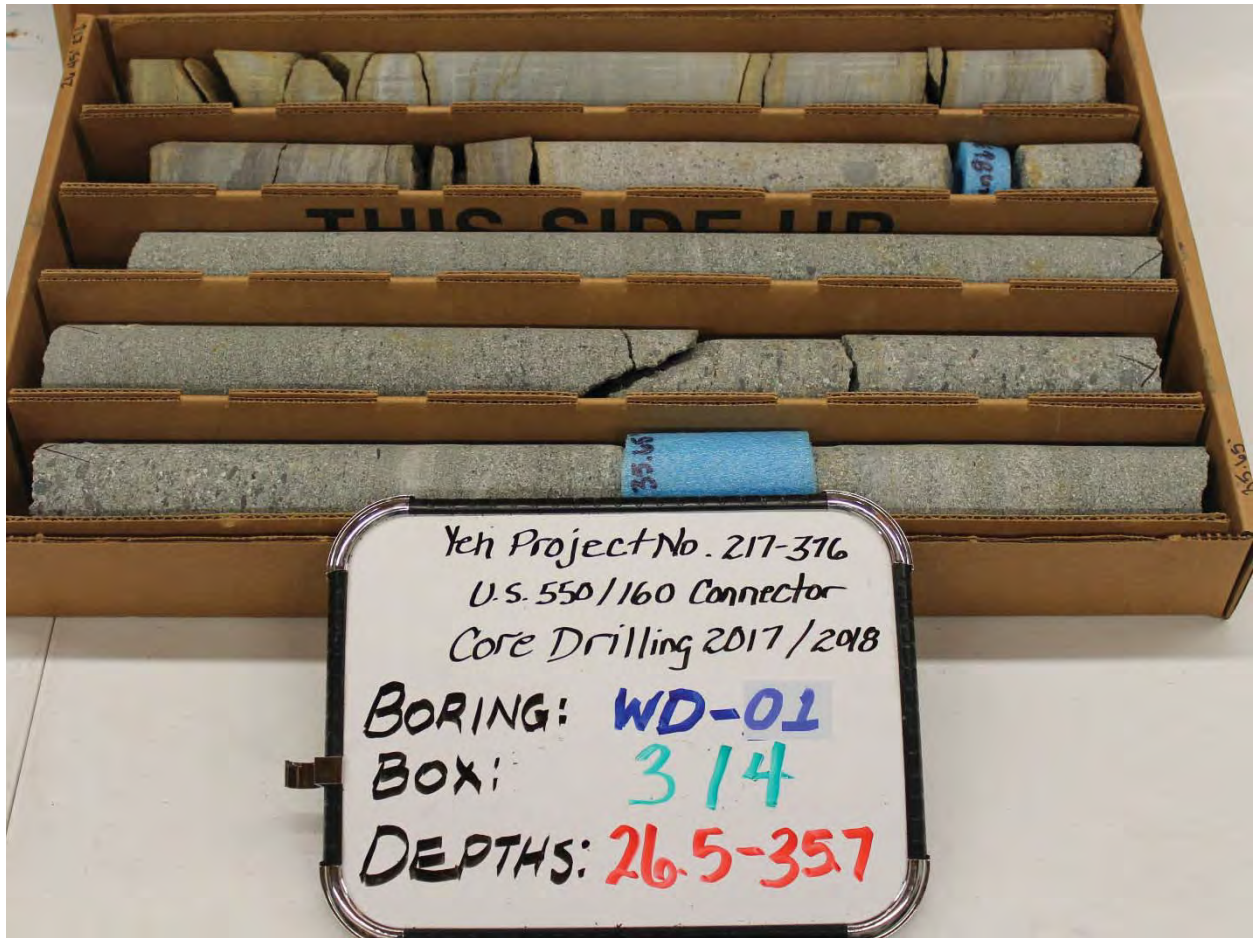
Box : 3/3

Depths : 57.6 - 67.6











**Appendix G – Site and Drilling Operations Photos**

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**CME ATV Rig at Boring R-04**



**Helicopter Placing Portable Rig at Boring D-01**



**Portable Viper Rig at Boring B1-04**





**CME ATV Rig at Boring R-07**



**Portable Burley Rig at Boring B1-12**





**Acker Track Rig at Boring A-1**



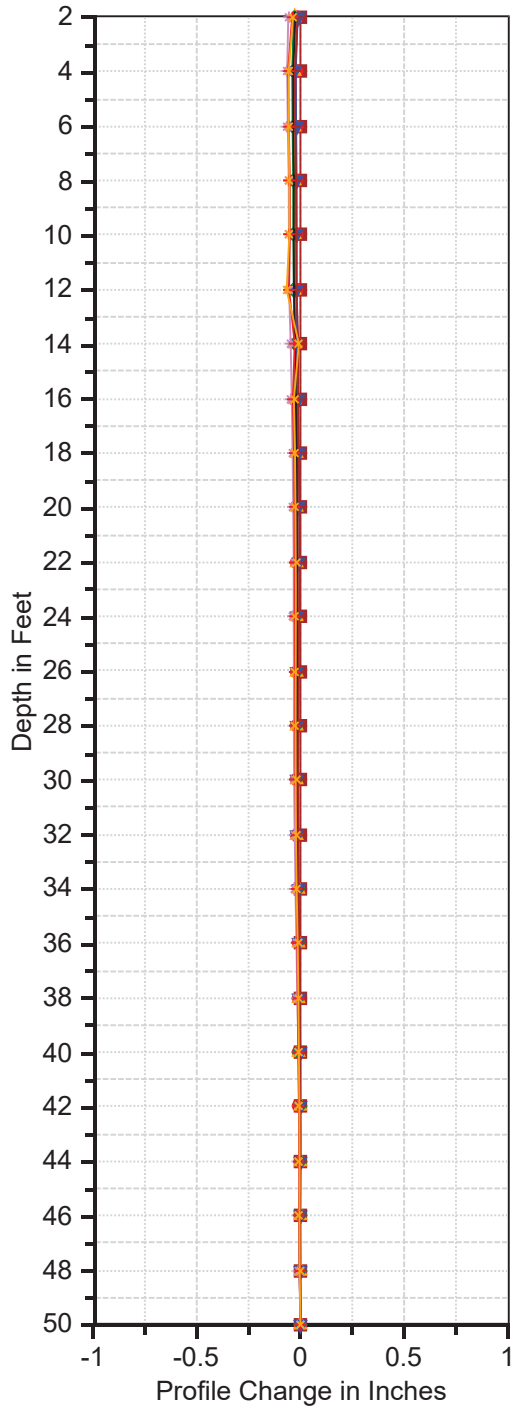
**Portable Viper Rig at Boring B1-10**



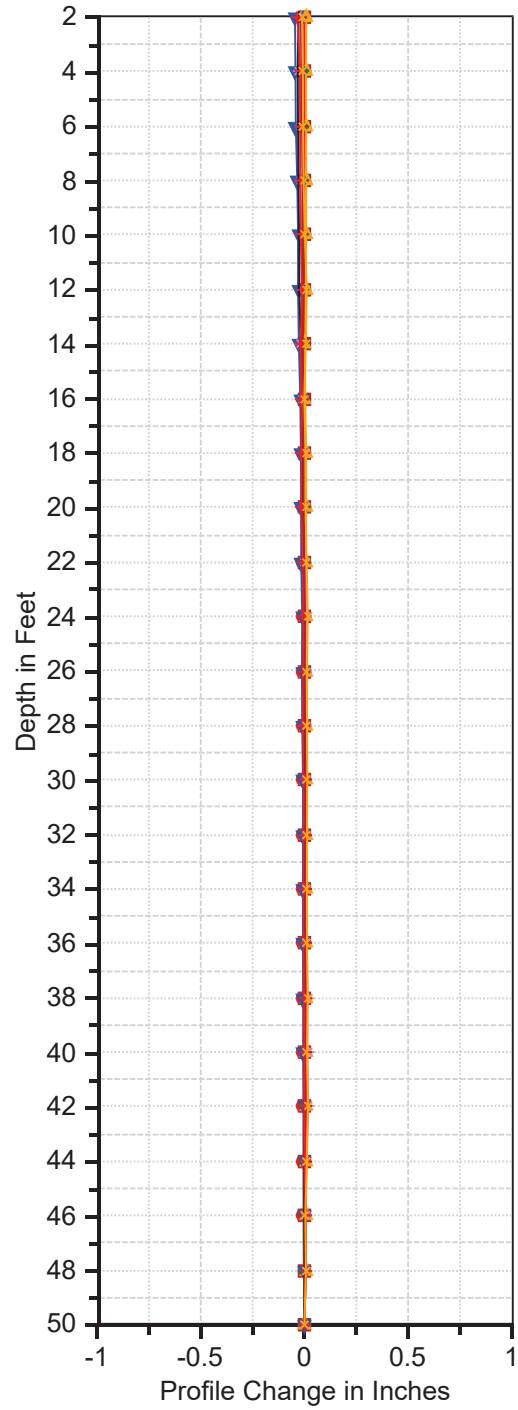
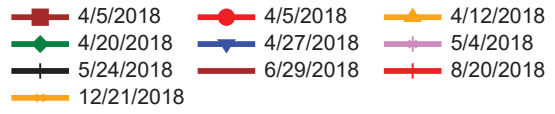
**Appendix H – Inclinometer Data**

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550160 B1\_3 A

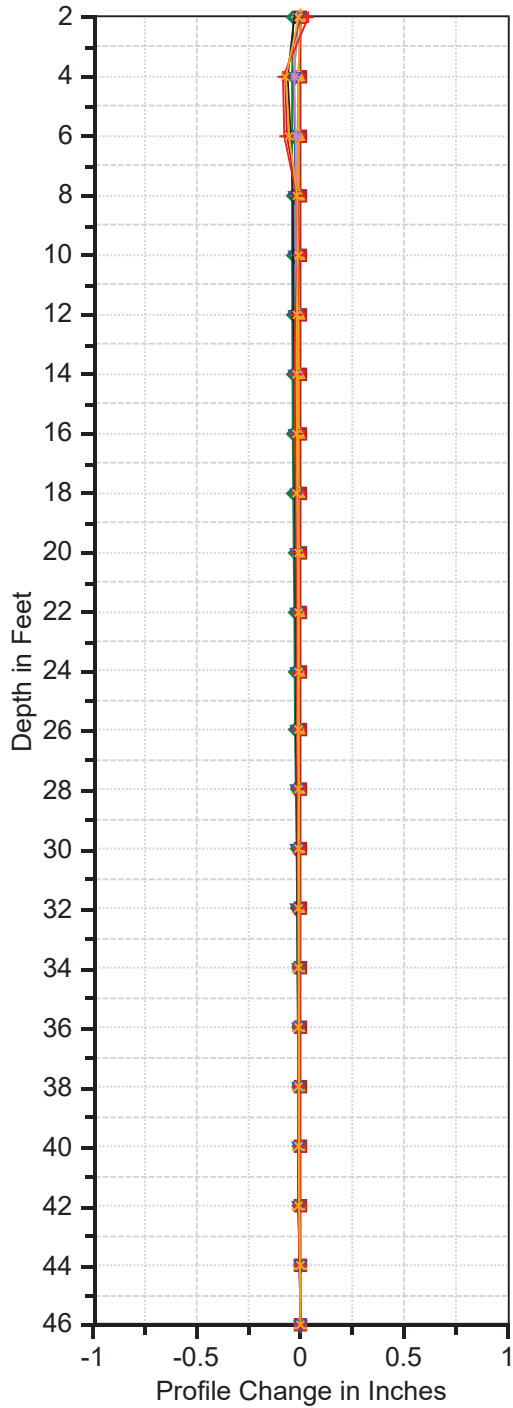
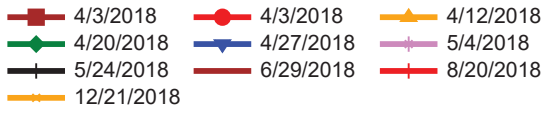


550160 B1\_3 B

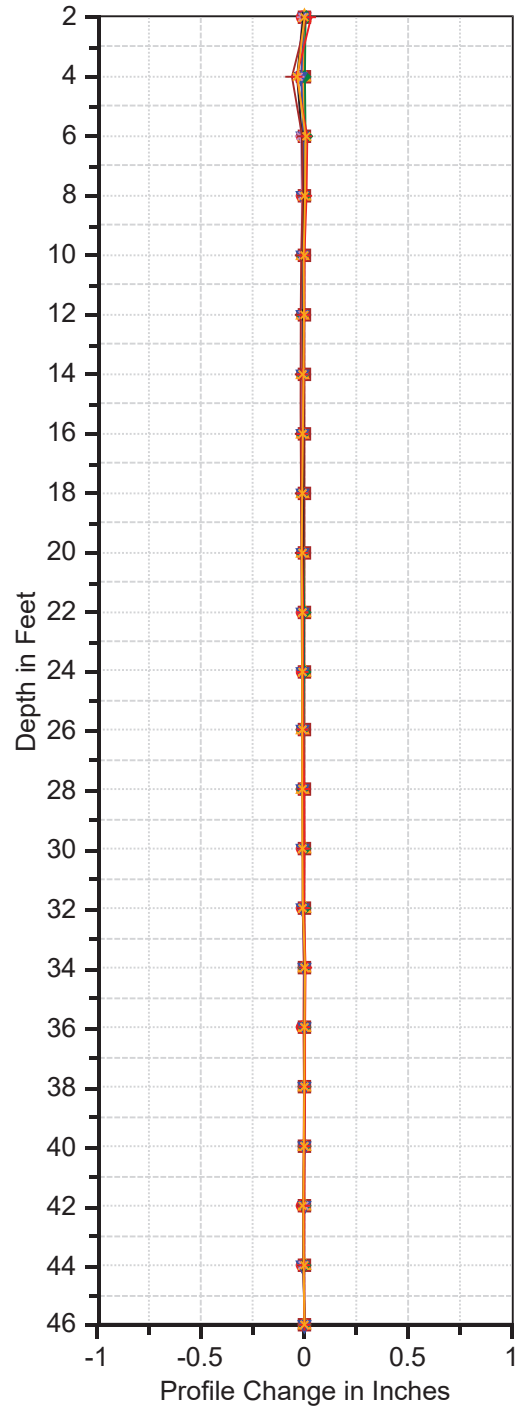
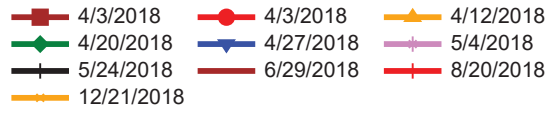




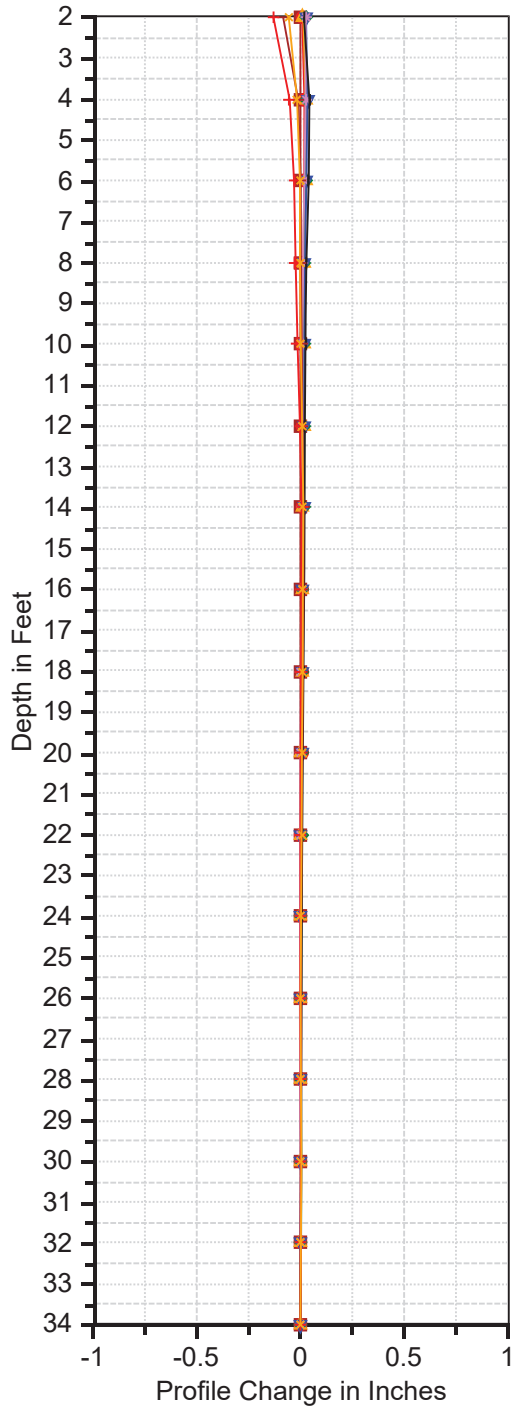
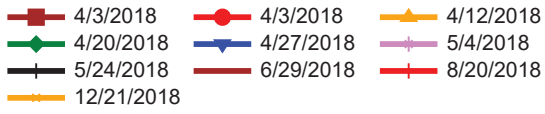
550160 B1\_5 A



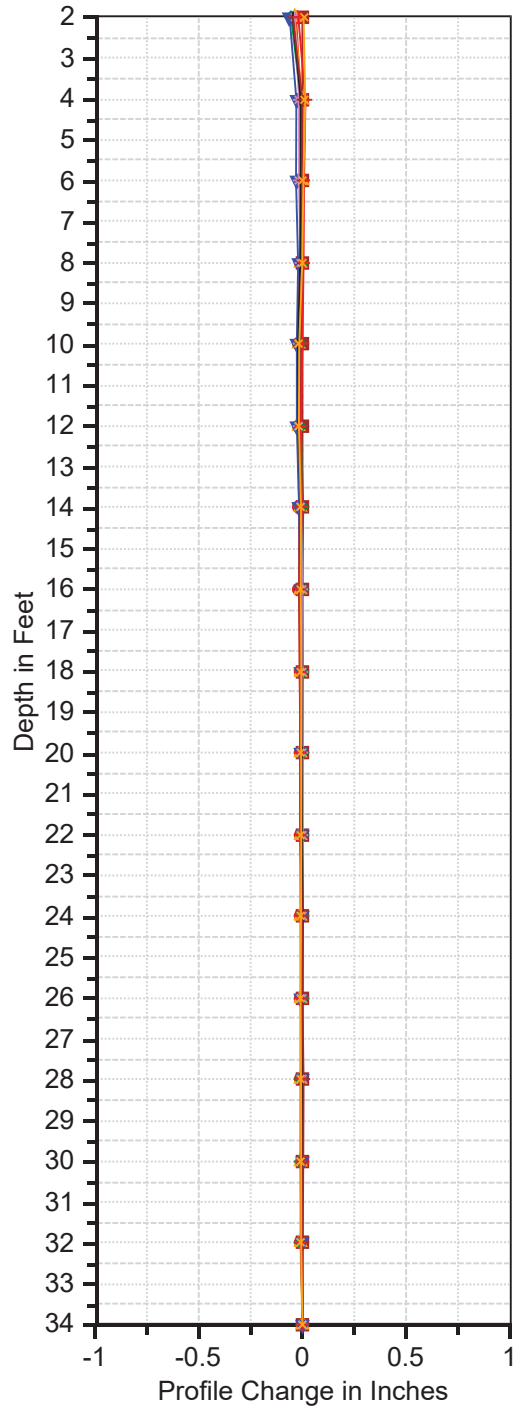
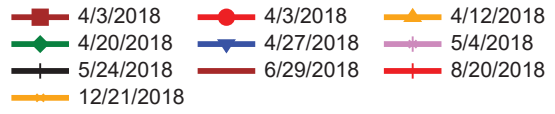
550160 B1\_5 B



550160 B1\_6 A

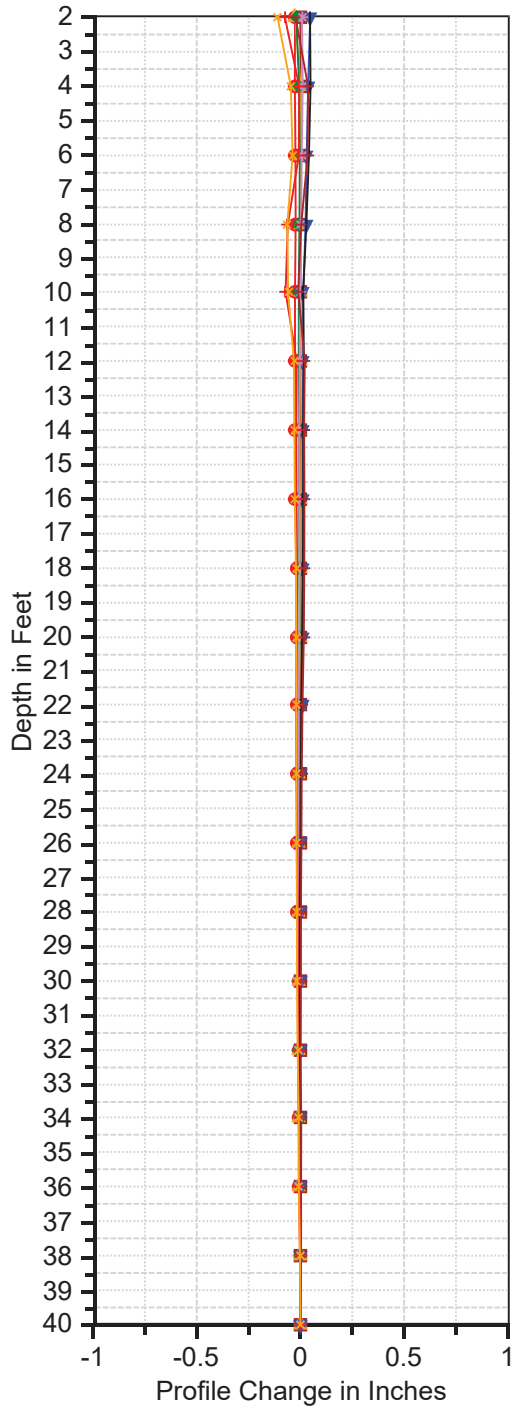
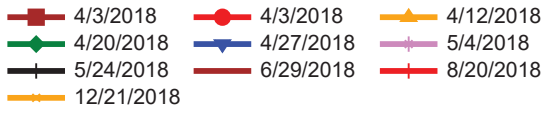


550160 B1\_6 B

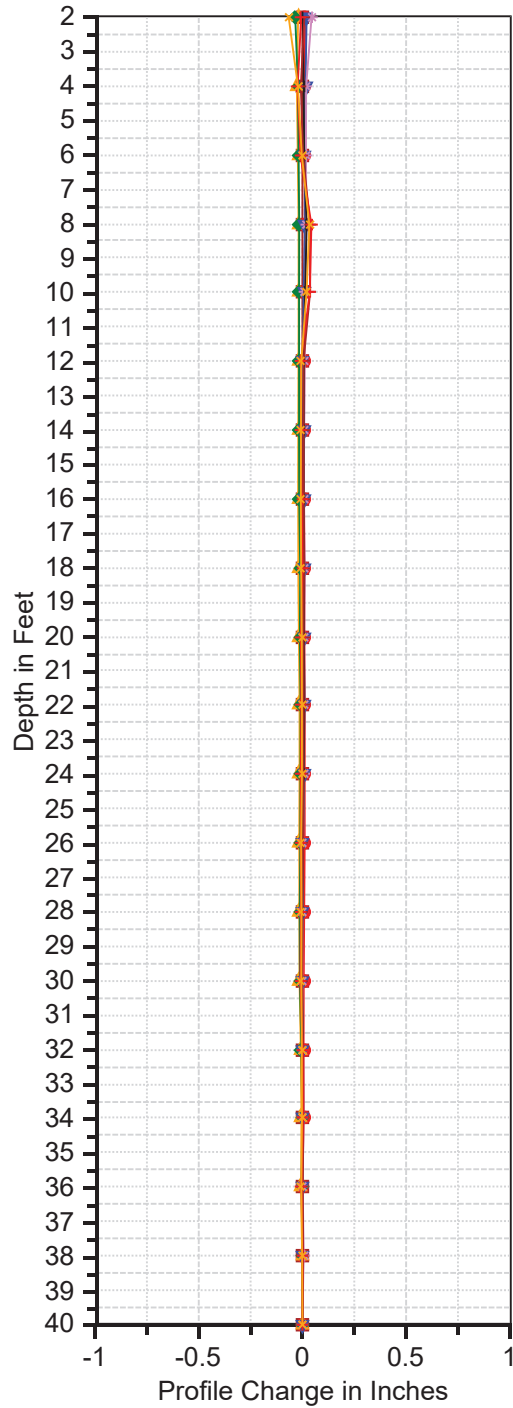
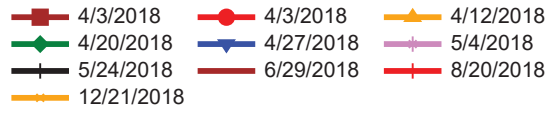




550160 B1\_7 A



550160 B1\_7 B



**Appendix I Summary Geotechnical Data Report – MM 12.3 to MM 15.0**





February 7, 2019

Yeh Project No. 217-376

Don Connors, P.E.  
Vice President  
Wood, PLC  
600 17<sup>th</sup> Street, Suite 500 – South Tower  
Denver, Colorado 80202

**Re: 22420 US 550 South Connection to US 160  
Summary Geotechnical Data Report – MM 12.3 to MM 15.0**

Dear Mr. Connors:

A preliminary geotechnical investigation was performed by Yeh and Associates, Inc. (Yeh) in 2007 for the proposed reconstruction of US Highway 550 from Milepost 2.76 (Station 245+85) to Milepost 15.24 (Station 971+93). The purpose of the investigation was to provide recommendations to be used in preliminary design. Results and recommendations were presented to HDR, Inc. in Yeh's April 7, 2008 "Draft Geotechnical Investigation Report for Preliminary Design" for CDOT Project No. NH 5501-011 (Project Code 12979). Borings drilled north of the intersection with County Road (CR) 302 (approximate MM 12.3) and south of the intersection with CR 220 (approximate MM 15.0) for the 2007 investigation can supplement information on subsurface conditions that may be encountered south of the limits addressed in Yeh's 2019 Geotechnical Data Report (GDR). Pertinent excerpts from the 2007 investigation, amended as necessary, are provided below.

## **GEOLOGIC SETTING**

Surficial deposits on the Florida Mesa consist of alluvium and terrace gravels. The near surface soils are predominantly sandy clay and clayey sand ("surficial soils" in the GDR) overlying dense sandy gravel containing cobbles and boulders ("terrace alluvium" in the GDR).

## **SUBSURFACE INVESTIGATION**

The 2007 preliminary soils investigation was performed to evaluate subsurface conditions related to pavement design. The borings were drilled to depths ranging from 10 to 21 feet below existing grade. A truck-mounted CME 75 drill rig using Hollow-stem augers drilled borings located within the roadway embankment prism, and a track-mounted Diedrich D-50 drill rig using solid stem augers was

employed for borings outside the roadway prism. The borings were logged by a representative of Yeh and Associates.

Soil samples from the auger borings were obtained using Penetration Tests (PT) at selected depths. To perform the PT, a 1.5-inch inside diameter split spoon sampler was seated at the bottom of the bore hole, then driven up to 18 inches with blows from an automatic standard hammer weighing 140 pounds and falling a distance of 30 inches. The number of blows required to drive the sampler the final 12 inches or a fraction thereof, constitutes the penetration resistance (N). The N value, as described in ASTM D 1586, when properly evaluated, is an index to the consistency or relative density of the material tested. Bulk samples of the solid auger cuttings were also obtained from the borings.

Due to the preliminary nature of the 2007 investigation and limitations of right-of-way, the borings were spaced at greater distances than are required by the CDOT Geotechnical Design Manual. The locations, total depth, and depths to subsurface strata are summarized in Table 1. Boring logs are provided in Attachment 1 to this document.

**Table 1 - Summary of Borings**

Boring Number	US 550 Station	Offset	Depth of Boring (ft)	Elev. Top of Boring (ft)	Depth to Surficial Soil (ft)	Depth to Alluvium (ft)	Elev. Top of Alluvium (ft)
YA-A23	797+20	60' Rt.	11.0	6594	0.0	n/a	n/a
YA-34	807+90	70' Lt.	10.0	6597	2.5	9.0	6588
YA-35	867+70	30' Lt.	10.0	6649	2.0	n/a	n/a
YA-36	877+60	20' Lt.	10.0	6688	2.0	n/a	n/a
YA-A24	883+00	60' Lt.	21.0	6676	0.0	n/a	n/a
YA-38	948+85	25' Lt.	10.0	6729	6.0	n/a	n/a
YA-A25	961+60	50' Lt.	21.0	6709	0.0	n/a	n/a

Borings ranged in depth from 10 to 21 feet. The four “YA” borings were drilled in May 2007 and were located within the existing highway embankment prism. Thicknesses of the fill ranged from 2 to 6 feet. Native surficial soil material was encountered beneath the fill and at the ground surface for the remaining borings (“YA-A”), which were drilled in September 2007 outside the existing fill.

## LABORATORY TESTING

Laboratory tests were performed on selected samples from the preliminary soil investigation. The tests included natural moisture content and dry density, gradation, Atterberg limits (AASHTO T 89 and





T 90), R-value (AASHTO T 190), pH (AASHTO T 289), resistivity (AASHTO T 288) and sulfate content (AASHTO T 290). Results of the laboratory testing are shown on the boring logs and presented in Attachment 2 to this document. Sieve analyses and swell/consolidation graphs are provided in Attachments 3 and 4, respectively.

## **SUBSURFACE CONDITIONS**

The existing highway is constructed on an embankment. Borings that were drilled in the existing roadway embankment encountered 2 to 6 feet of fill consisting of sand and gravel containing silt and clay. Below the fill, and in borings drilled outside the existing roadway prism, the soils encountered generally consist of silty clay, with sand contents ranging from 10 to 32 percent. The percent fines (passing the #200 sieve) ranged from 68 to 90 percent, while the Plasticity Index (PI) ranged from 17 to 28. Using the Unified Soil Classification System (USCS), the soils were classified as CL, lean clay. Under the AASHTO system, soil classifications of A-6 (group indices ranging from 9 to 17) and A-7-6 (group indices of 24 to 25) were determined. Natural moisture contents fell between 7.1 and 19.5 percent and the natural dry density ranged between 94.8 and 107.6 pounds per cubic foot (pcf). Swell/consolidation tests were run on two samples from outside the roadway prism; values of -4.4% and -3.7% (consolidation) were reported. The pH of the surficial soils was slightly alkaline, between 7.8 and 8.1. Water soluble sulfate was measured for four samples and ranged from 0.001 to 0.028 percent. Two samples were tested for resistivity, and found to have levels of 725 and 1600 Ohm-cm. Bulk samples for Hveem Resistance R-value testing were obtained from two borings. The reported R-values were 7 and 10. Groundwater was not encountered in the borings.

## **LIMITATIONS**

This study has been conducted in accordance with generally accepted geotechnical engineering practices in this area for use by the client for preliminary design purposes. The nature and extent of subsurface variations across the site may not become evident until excavation is performed. The data presented in this Summary Report is intended to supplement the data in the GDR for specific use on the US 550-US 160 Connection Design-Build project. Within the limitations of the scope, schedule, and budget, the work presented in this report was performed in accordance with generally accepted geotechnical engineering principles and practices in this area at the time this report was prepared. We make no other warranty, either explicit or implied.

The conclusions regarding subsurface conditions presented in this report are based on the data obtained from published maps, reports, laboratory tests, and the widely spaced exploratory borings drilled at the approximate locations shown on the boring location sheets. When assigning laboratory



tests, it was assumed that these widely spaced borings are representative of the subsurface conditions throughout the US 550 project alignment discussed in the report and that the subsurface conditions throughout the project alignment are not significantly different from those identified by the borings. The subsurface conditions observed in the borings may not necessarily reflect the field variations in the subsurface conditions and water levels at other locations. The nature and extent of subsurface variations across the project area may not become evident until construction activities are initiated.

The scope of work of this investigation did not include hazardous materials sampling and chemical analyses and evaluation of potential impacts to natural resources, including wetlands, endangered species, or environmentally critical areas.

If you have any questions, please contact me (970) 382-9590.

Sincerely,

**YEH AND ASSOCIATES, INC.**



Thomas L. Allen, P.E.  
Senior Project Manager

Attachments (4)

- 1) Boring Logs
- 2) Summary of Laboratory Test Results
- 3) Sieve Analyses
- 4) Swell/Consolidation Graphs





Boring Began: 9/12/2007  
 Drilling Method: Solid-Stem Auger  
 Drill: D50 T  
 Driller: DA Smith Drilling - Roger  
 Logged By: RF  
 Final By: T. Allen  
 Inclination: Vertical

Completed: 9/12/2007  
 Drill Bit:  
 Casing:  
 Weather:

Total Depth: 11.0 ft  
 Ground Elevation:  
 Location: Station 797+20, 60 ft Rt of Centerline  
 Coordinates: N: E:

Ground Water Notes:

Depth	-	-	-	-
Date	-	-	-	-
Time	-	-	-	-

Elevation (feet)	Depth (feet)	Run / Sample Type	Recovery (%)	Soil Samples		Lithology	Material Description	Field Notes and Lab Tests
				RQD	Blows per 6 in			
							<b>0.0 - 11.0 ft. silty CLAY</b> , reddish brown, medium plasticity, moist, very stiff to hard.	#200= 84% LL= 37 PL= 16 PI= 21 R-Value= 10 AASHTO: A-6 (17) USCS: CL  pH= 8.1 S= 0.009%
				8/12/22	34		Gravels, cobbles, small bentonite seams.	
	10			8/14/15	29			
							Bottom of Hole at 11.0 ft.	



Boring Began: 5/30/2007

Drilling Method: Hollow-Stem Auger

Drill: CME 75

Driller: Envirotech - Danny

Logged By: RF

Final By: T. Allen

Inclination: Vertical

Completed: 5/30/2007

Drill Bit:

Casing:

Weather:

Total Depth: 10.0 ft

Ground Elevation:

Location: Station 807+90, 70 ft Lt of Centerline

Coordinates: N: E:

Ground Water Notes:

Depth	-	-	-	-
Date	-	-	-	-
Time	-	-	-	-

Elevation (feet)	Depth (feet)	Run / Sample Type	Recovery (%)	Soil Samples		Lithology	Material Description	Field Notes and Lab Tests
				Rock	N			
			RQD	Blows per 6 in				
							0.0 - 2.5 ft. <b>gravelly SAND</b> slightly clayey and silty, moist, embankment FILL.	
	5			5/4/7	11		2.5 - 9.0 ft. <b>silty CLAY</b> , brown, medium plasticity, moist, stiff.	MC= 19.5% #200= 90% LL= 42 PL= 15 PI= 27 AASHTO: A-7-6(24) USCS: CL
	10			5/9/11	20		9.0 - 10.0 ft. <b>gravelly CLAY</b> , brown, moist, medium dense, very stiff.	
							Bottom of Hole at 10.0 ft.	





Boring Began: 5/31/2007

Drilling Method: Hollow-Stem Auger

Drill: CME 75

Driller: Envirotech - Danny

Logged By: RF

Final By: T. Allen

Inclination: Vertical

Completed: 5/31/2007

Drill Bit:

Casing:

Weather:

Total Depth: 10.0 ft

Ground Elevation:

Location: Station 867+70, 30 ft Lt of Centerline

Coordinates: N: E:

Ground Water Notes:

Depth	-	-	-	-
Date	-	-	-	-
Time	-	-	-	-

Elevation (feet)	Depth (feet)	Run / Sample Type	Recovery (%)	Soil Samples		Lithology	Material Description	Field Notes and Lab Tests
				Rock RQD	Blows per 6 in N			
							<p>0.0 - 2.0 ft. <b>gravelly SAND</b> clayey, silty, brown, moist, FILL.</p> <p>2.0 - 10.0 ft. <b>silty CLAY</b>, brown, medium plasticity, moist, stiff.</p>	MC= 19% #200= 88% LL= 43 PL= 15 PI= 28 AASHTO: A-7-6(25) USCS: CL
	5				5/4/7	11		
	10				1/6/9	15		
							Bottom of Hole at 10.0 ft.	



Boring Began: 5/31/2007

Drilling Method: Hollow-Stem Auger

Drill: CME 75

Driller: Envirotech - Danny

Logged By: RF

Final By: T. Allen

Inclination: Vertical

Completed: 5/31/2007

Drill Bit:

Casing:

Weather:

Total Depth: 10.0 ft

Ground Elevation:

Location: Station 877+60, 20 ft Lt of Centerline

Coordinates: N: E:

Ground Water Notes:

Depth	-	-	-	-
Date	-	-	-	-
Time	-	-	-	-

Elevation (feet)	Depth (feet)	Run / Sample Type	Recovery (%)	Soil Samples		Lithology	Material Description	Field Notes and Lab Tests
				Rock	N			
			RQD	Blows per 6 in				
							0.0 - 2.0 ft. <b>gravelly SAND</b> slightly clayey, silty, brown, moist, FILL.	MC= 7.1% #200= 69% LL= 40 PL= 17 PI= 23 pH= 7.8 S= 0.007% R-Value= 7 Re= 725ohms-cm AASHTO: A-6 (14) USCS: CL
	5			3/3/7	10		2.0 - 10.0 ft. <b>sandy CLAY</b> , brown, medium plasticity, moist, soft to stiff.	
	10			3/4/4	8			
							Bottom of Hole at 10.0 ft.	





Boring Began: 9/12/2007  
 Drilling Method: Solid-Stem Auger  
 Drill: D50 T  
 Driller: DA Smith Drilling - Roger  
 Logged By: RF  
 Final By: T. Allen  
 Inclination: Vertical

Completed: 9/12/2007  
 Drill Bit:  
 Casing:  
 Weather:

Total Depth: 21.0 ft  
 Ground Elevation:  
 Location: Station 883+00, 60 ft Lt of Centerline  
 Coordinates: N: E:

Ground Water Notes:

Depth	-	-	-	-
Date	-	-	-	-
Time	-	-	-	-

Elevation (feet)	Depth (feet)	Run / Sample Type	Recovery (%)	Soil Samples		Lithology	Material Description	Field Notes and Lab Tests
				RQD	Blows per 6 in			
					12/9	21	0.0 - 21.0 ft. silty CLAY sandy, brown to reddish brown, medium plasticity, moist to dry, very stiff.	#200= 68% LL= 35 PL= 18 PI= 17 pH= 7.9 S= 0.001% Re= 1600ohms-cm AASHTO: A-6 (9) USCS: CL MC= 14% DD= 103.5pcf S/C= -4.4%
	10				10/12	22		
					11/13/12	25		
	20				12/11/10	21		
							Bottom of Hole at 21.0 ft.	
	30							
	40							



Boring Began: 5/30/2007

Drilling Method: Hollow-Stem Auger

Drill: CME 75

Driller: Envirotech - Danny

Logged By: RF

Final By: T. Allen

Inclination: Vertical

Completed: 5/30/2007

Drill Bit:

Casing:

Weather:

Total Depth: 10.0 ft

Ground Elevation:

Location: Station 948+85, 25 ft Lt of Centerline

Coordinates: N: E:

Ground Water Notes:

Depth	-	-	-	-
Date	-	-	-	-
Time	-	-	-	-

Elevation (feet)	Depth (feet)	Run / Sample Type	Recovery (%)	Rock	Soil Samples		Lithology	Material Description	Field Notes and Lab Tests
				RQD	Blows per 6 in	N			
								<b>0.0 - 6.0 ft. gravelly CLAY</b> silty, sandy, brown-gray, moist, FILL.	
	5				5/8/9	17			
								<b>6.0 - 10.0 ft. silty CLAY</b> , brown, medium plasticity, moist, stiff.	
	10				4/7/11	18			MC= 15.6% #200= 90% LL= 42 PL= 14 PI= 28 AASHTO: A-7-6(25) USCS: CL
								Bottom of Hole at 10.0 ft.	
	15								





Boring Began: 9/12/2007  
 Drilling Method: Solid-Stem Auger  
 Drill: D50 T  
 Driller: DA Smith Drilling - Roger  
 Logged By: RF  
 Final By: T. Allen  
 Inclination: Vertical

Completed: 9/12/2007  
 Drill Bit:  
 Casing:  
 Weather:

Total Depth: 21.0 ft  
 Ground Elevation:  
 Location: Station 961+60, 50 ft Lt of Centerline  
 Coordinates: N: E:

Ground Water Notes:

Depth	-	-	-	-
Date	-	-	-	-
Time	-	-	-	-

Elevation (feet)	Depth (feet)	Run / Sample Type	Recovery (%)	Soil Samples		Lithology	Material Description	Field Notes and Lab Tests
				RQD	Blows per 6 in			
							0.0 - 21.0 ft. silty CLAY, brown grades to reddish brown, dry to moist, stiff to hard.	MC= 10.2% DD= 94.8pcf S/C= -3.7%  MC= 12.3% DD= 107.6pcf pH= 8 S= 0.028%
					9/7	16		
	10				13/18	31		
					7/13/17	30		
	20				10/14/20	34		
							At 17 ft, grades to reddish brown.	
							Bottom of Hole at 21.0 ft.	



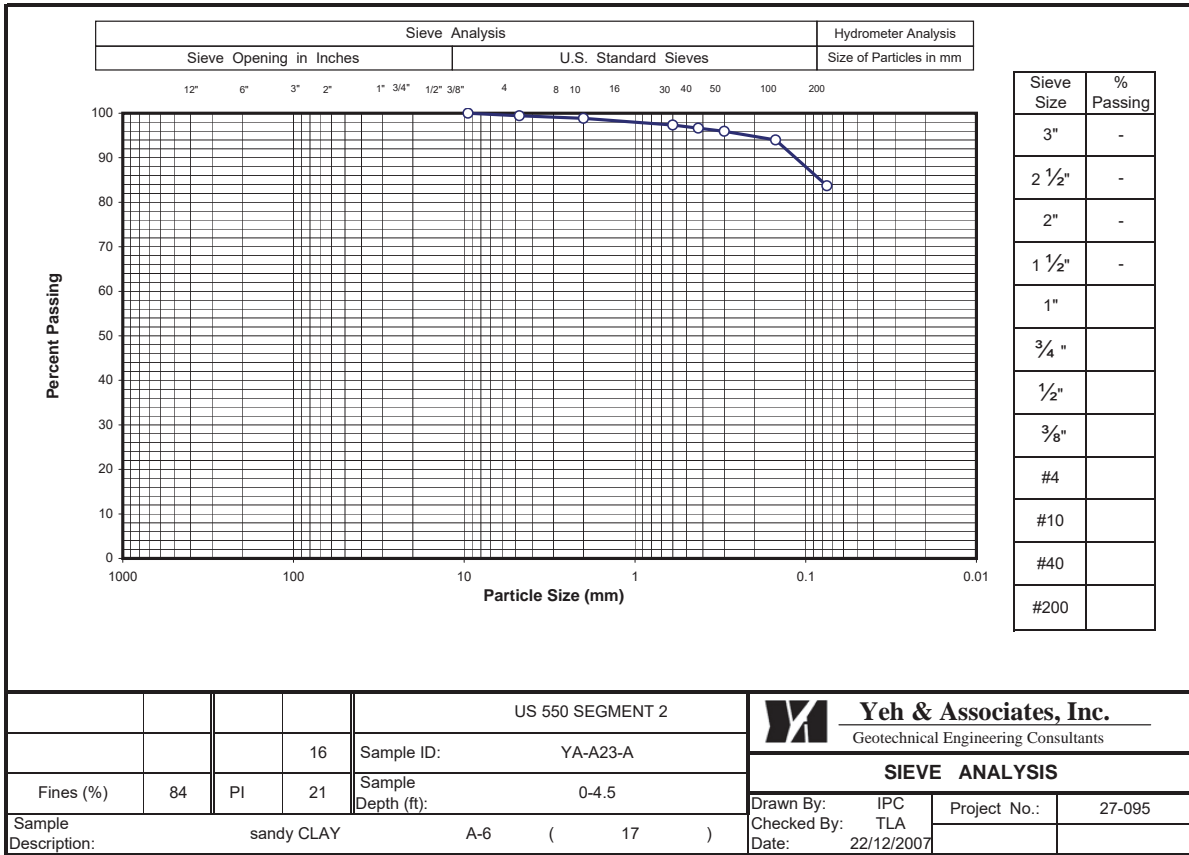
# YEH & ASSOCIATES, INC

## Summary of Laboratory Test Results

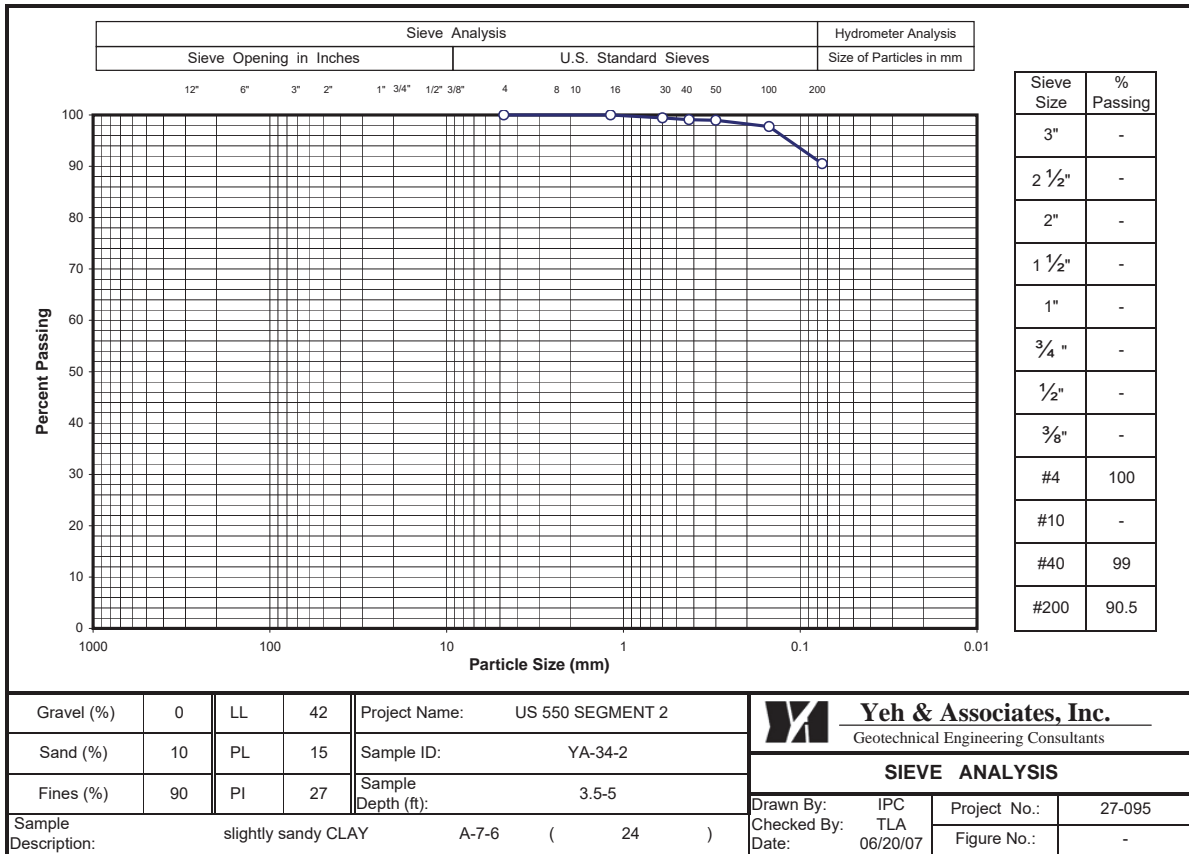
Project No: 27-095 Project Name: US 550 SEG 2 Date: 3/31/08

Sample Location				Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits			pH	Water Soluble Sulfate %	% Swell (+) / Consolidation (-)	Resistivity (ohms-cm)	R-VALUE	CLASSIFICATION	
Sample No.	Station	Depth (ft)	Sample Type			Gravel > #4 (%)	Sand (%)	Fines < #200 (%)	LL	PL	PI						AASHTO	USCS
YA-A23-A	797+20, 60' R	0-4.5	Bulk			1	16	84	37	16	21					10	A-6 ( 17 )	CL
YA-A23-B	797+20, 60' R	5	SPT									8.1	0.009					CL
YA-34-2	807+90, 70' L	4	SS	19.5		0	10	90	42	15	27						A-7-6 ( 24 )	CL
YA-35-2	867+70, 30' L	4	SS	19.0		0	12	88	43	15	28						A-7-6 ( 25 )	CL
YA-36-3	877+60, 20' L	5-8.5	Bulk	7.1		1	30	69	40	17	23	7.8	0.007		725	7	A-6 ( 14 )	CL
YA-A24-A	883+00, 60' L	0-4.5	Bulk			0	32	68	35	18	17	7.9	0.001		1600		A-6 ( 9 )	CL
YA-A24-B	883+00, 60' L	5	CAL	14.0	103.5									-4.4				CL
YA-38-4	948+85, 25' L	9	SS	15.6		0	10	90	42	14	28						A-7-6 ( 25 )	CL
YA-A25-B	961+60, 50' L	5	CAL	10.2	94.8									-3.7				CL
YA-A25-D	961+60, 50' L	10	CAL	12.3	107.6							8.0	0.028					CL

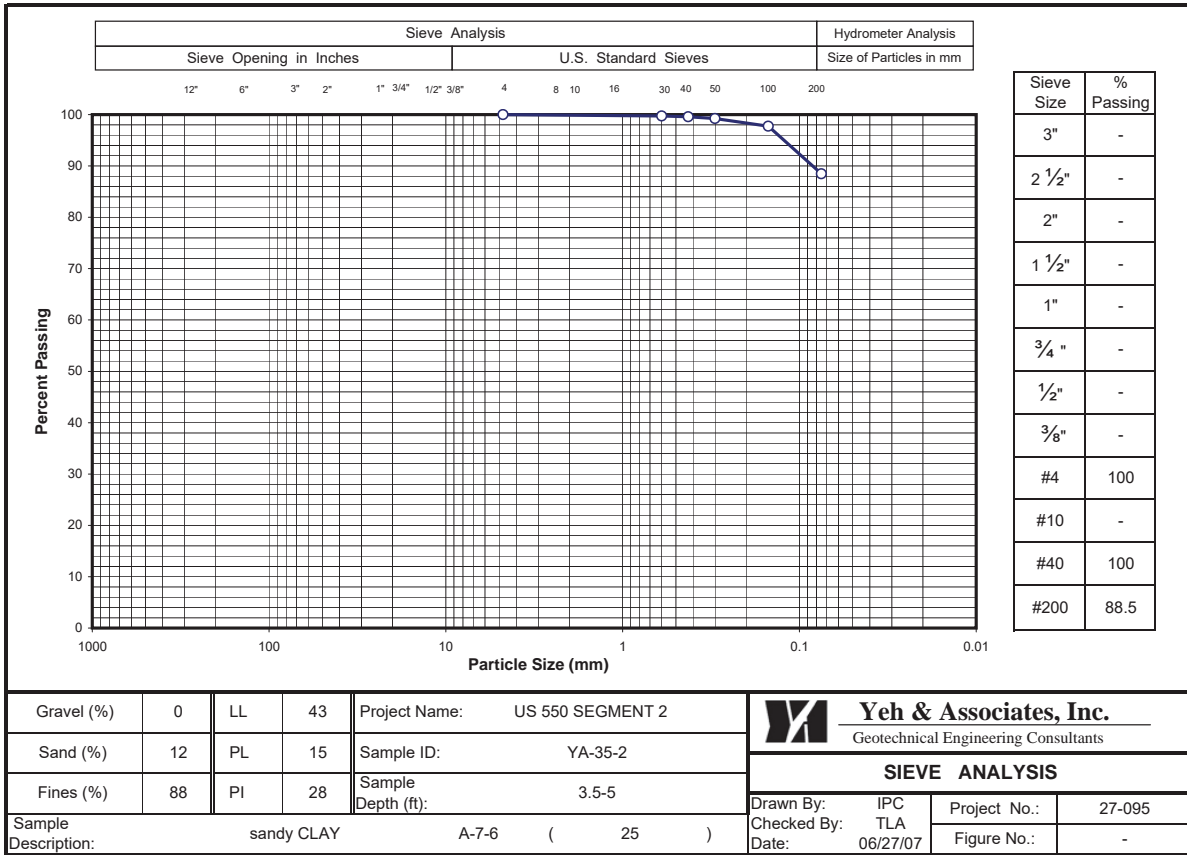




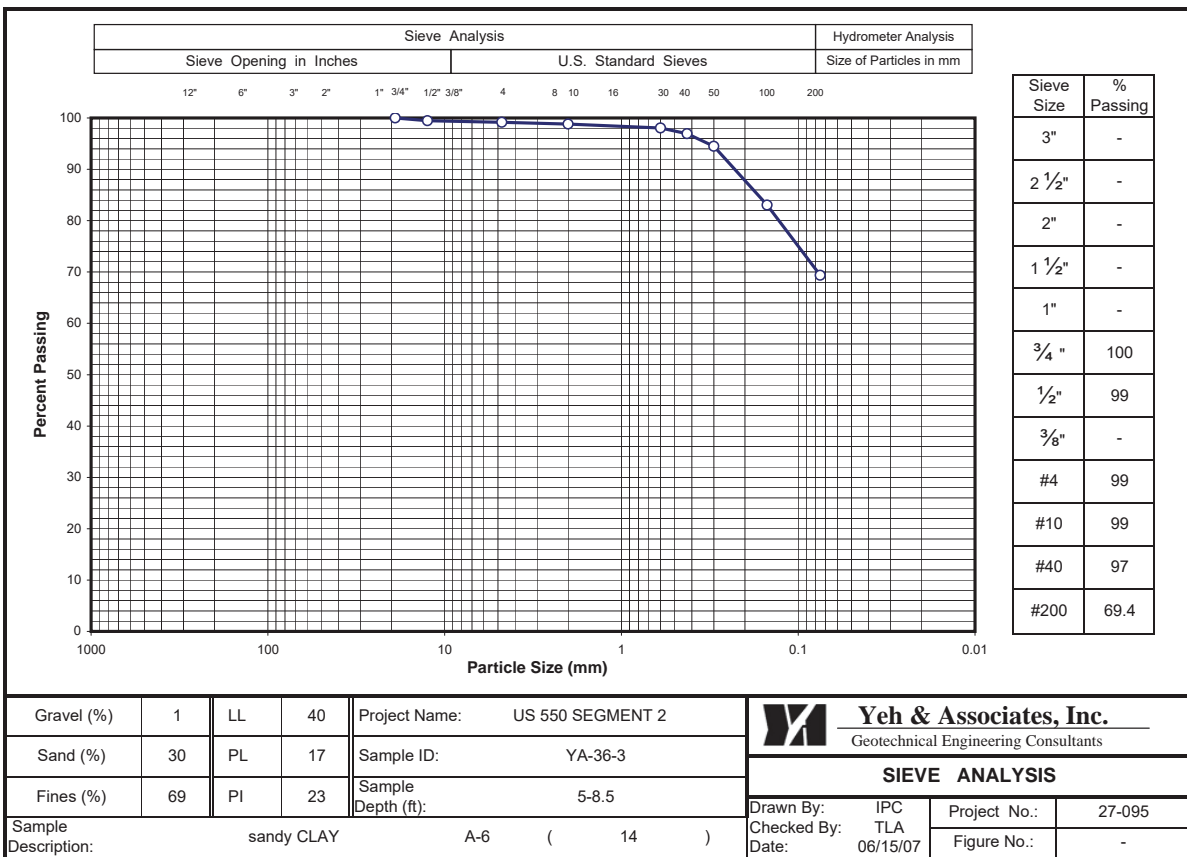
Revised 04/27/2004



Revised 04/27/2004

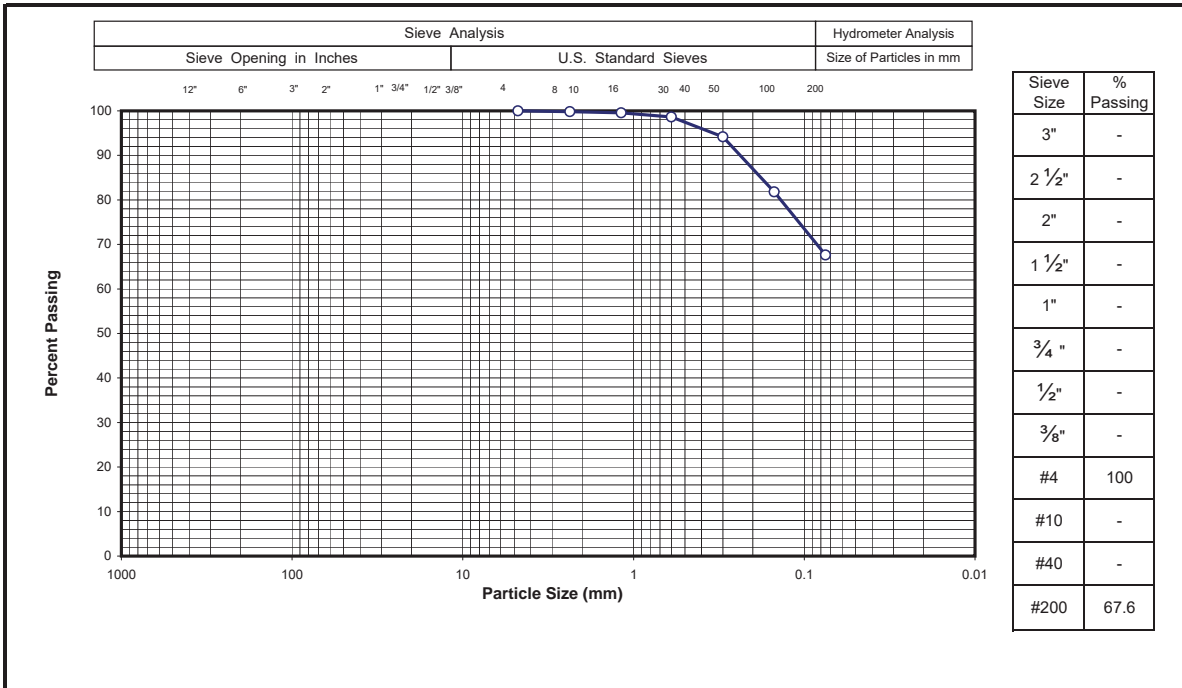


Revised 04/27/2004



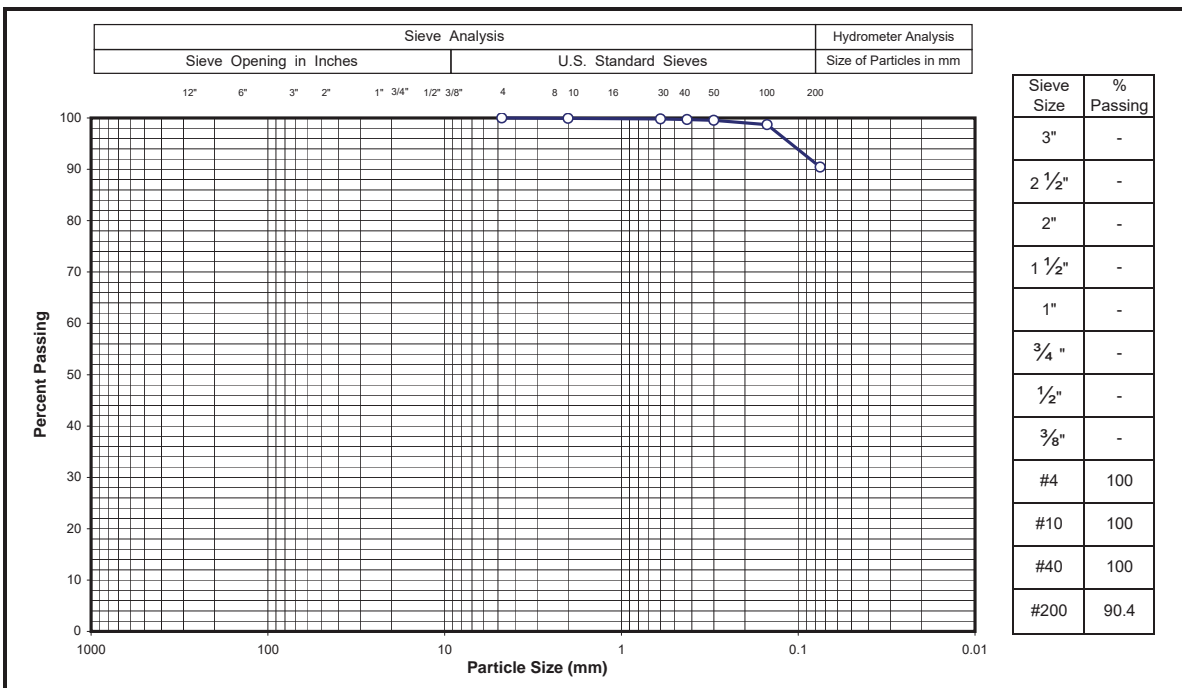
Revised 04/27/2004





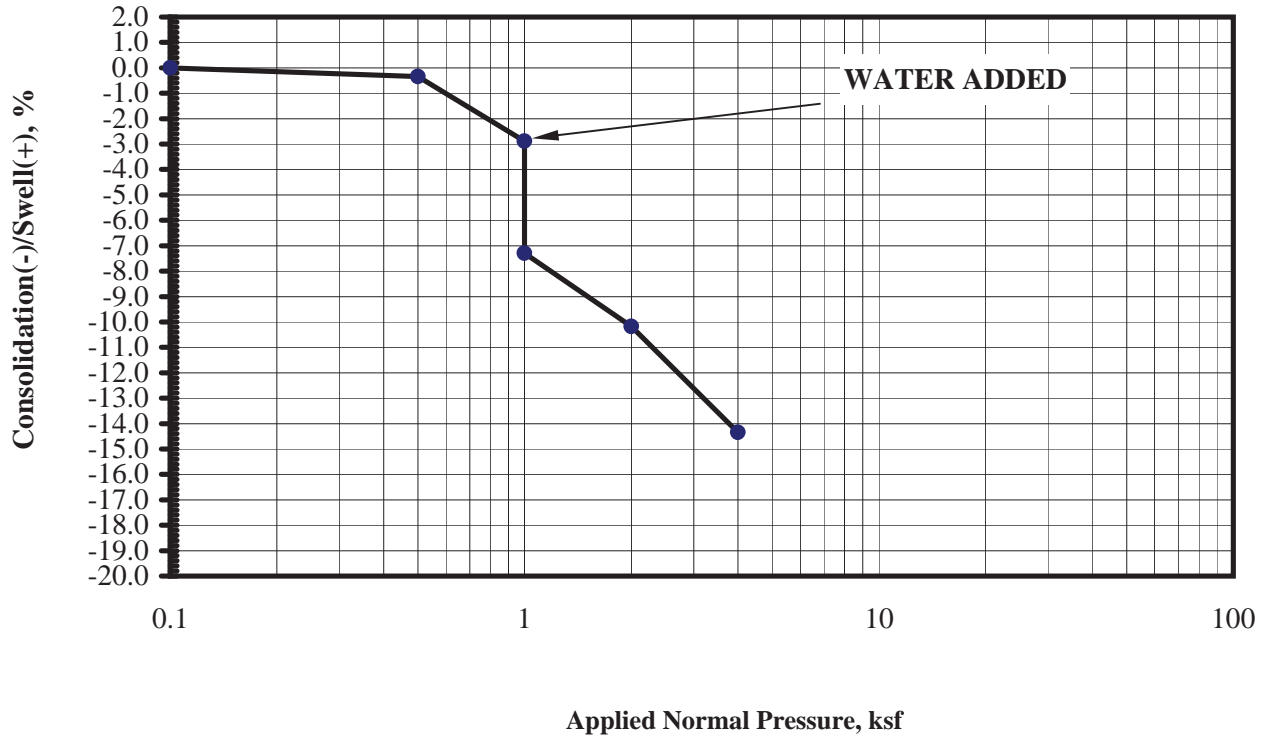
Gravel (%)	0	LL	35	Project Name:	US 550 SEGMENT 2	<b>Yeh &amp; Associates, Inc.</b> Geotechnical Engineering Consultants	
Sand (%)	32	PL	18	Sample ID:	YA-A24-A		
Fines (%)	68	PI	17	Sample Depth (ft):	0-4.5		
Sample Description: sandy CLAY		A-6		( 9 )		<b>SIEVE ANALYSIS</b>	
				Drawn By:	IPC	Project No.:	27-095
				Checked By:	TLA	Figure No.:	-
				Date:	09/20/07		

Revised 04/27/2004



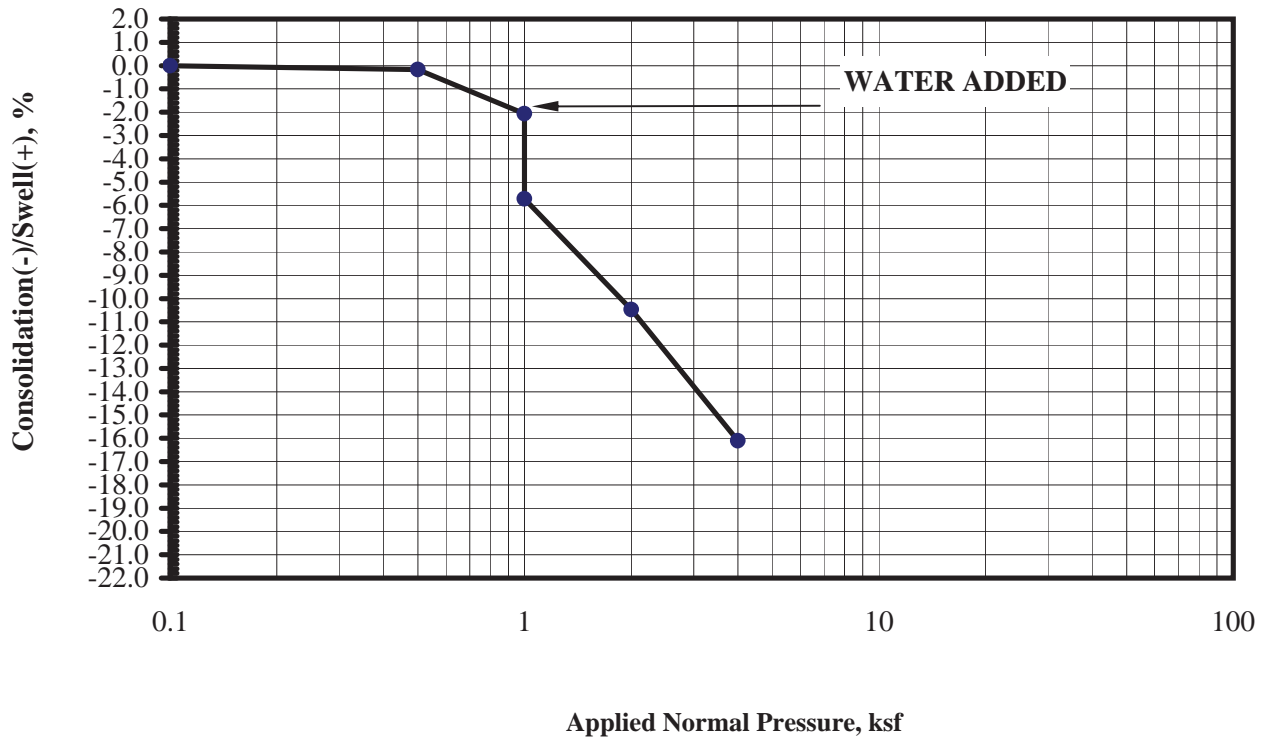
Gravel (%)	0	LL	42	Project Name:	US 550 SEGMENT 2	<b>Yeh &amp; Associates, Inc.</b> Geotechnical Engineering Consultants	
Sand (%)	10	PL	14	Sample ID:	YA-38-4		
Fines (%)	90	PI	28	Sample Depth (ft):	8.5-10		
Sample Description: slightly sandy CLAY		A-7-6		( 25 )		<b>SIEVE ANALYSIS</b>	
				Drawn By:	IPC	Project No.:	27-095
				Checked By:	TLA	Figure No.:	-
				Date:	06/15/07		

Revised 04/27/2004



Boring Number	Depth, ft	Natural Dry Density, pcf	Moisture Content, %	Consolidation(-) /Swell(+), %	Soil Description	SWELL / CONSOLIDATION GRAPH	
YA-A24-B	5	103.5	14.0	-4.4	CLAY	Drawn By:	IP
Job No: 27-095	Project Name: US 550 Segment 2					Checked By:	TA
<b>YEH &amp; ASSOCIATES, INC</b>							





Boring Number	Depth, ft	Natural Dry Density, pcf	Moisture Content, %	Consolidation(-) /Swell(+), %	Soil Description	SWELL / CONSOLIDATION GRAPH	
YA-A25-B	5	94.8	10.4	-3.7	CLAY	Drawn By:	IP
Job No: 27-095	Project Name: US 550 Segment 2					Checked By:	TA
<b>YEH &amp; ASSOCIATES, INC</b>							